SCIENCE ABSTRACTS.

Section A.—PHYSICS.

DECEMBER 1905.

GENERAL PHYSICS.

2138. *Viscosity of Ice.* **B. Weinberg.** (Ann. d. Physik, 18. 1. pp. 81–91, Oct. 12, 1905.)—The ice is cut into cylindrical and prismatic rods, the length being parallel to the optic axis. One end of the rod is fixed, the other end being subjected to a twist. The method of fixing the ice and of measuring the rate of angular rotation of various cross-sections is described. The coefficient of viscosity (μ) is calculated from the relation, torque $= (\mu\pi r^4/2l)(\delta\phi/\delta t)$, where r is the radius of the cylinder, l its length (between the layers considered), and $\delta\phi/\delta t$ the angular velocity of one of these layers with respect to the other. The relation between μ and temperature is found to be—

$$\mu = (1{\cdot}244 - 0{\cdot}502\mathrm{T} + 0{\cdot}0355\mathrm{T}^2)\frac{10^{13}\ \mathrm{gm.}}{\mathrm{cm.\ sec.}}$$

Using the displacement after 1 min., Young's modulus is found; it is of the order 10^9 gm./cm. sec.^{2} (5×10^9 at $-1°$ C.). S. G. S.

2139. *Distortion of Cylindrical Shell having Longitudinal Slot.* **V. Volterra.** (Accad. Lincei, Atti, 14. pp. 329–342, Oct. 1, 1905.)—The case in which the slot is made by radial planes has already been given [see Abstract No. 1674 (1905)], and in the present paper the case in which the slot is made by parallel planes is dealt with. The sides of the slot are pressed together and cemented. From the ordinary theory of elasticity the stresses and strains are calculated, and a shell of indiarubber is experimented upon and photographed. This shows the strains indicated by the calculation. The body is no longer a solid of revolution, and its shape is very different from that obtained in the case of the radial slot. S. G. S.

2140. *Simple Device Illustrating the Yielding of Columns.* **A. Sommerfeld.** (Zeitschr. Vereines Deutsch. Ing. 49. pp. 1320–1323, Aug. 12, 1905. Paper read before the Aachener Bezirksverein.)—The experiment is based on the principle that a column under a longitudinal load is in a very stable condition when the load is light, and that the stability decreases as the load increases, labile equilibrium being reached at the critical load; beyond this load the equilibrium is unstable and failure by bending occurs; this implies that the frequency of lateral vibration will diminish as the load is increased, reaching the zero value when the stability is zero. The experimental arrangement consists of a strip of steel plate which can be clamped in a vice with its free end either vertically upward or downward, the free end being fitted for the attachment of weights. The free period of such a strip is easily counted. When the free end is uppermost the stability of the system diminishes as the load is increased, and the number of vibrations per min. decreases with increasing load, the effect being increased by the increased moment of inertia. In the opposite position, however, the restoring forces increase as the load increases, and thus the effect of increasing inertia in lengthening the period is partly counterbalanced. The decreasing stability of a loaded column is thus demonstrated, and the value of the limiting load is readily determined. The author gives the mathematical theory of the experiment, and also suggests counting the vibrations of the same system in the horizontal position, where the variations of the free period depend upon the inertia effects alone. W. Ros.

2141. *Evaporation of Musk and other Odorous Substances.* **J. Aitken.** (Roy. Soc. Edinburgh, Proc. 25. pp. 894–902, 1904–5.)—The failure of musk-laden, but dust-free, air to give any cloudy condensation when supersaturated with moisture, and its ability to pass through tightly packed cotton-wool, lead to the conclusion that musk does not give off solid particles, but evaporates as a gas or vapour which acts on the sense of smell. Camphor, menthol, naphthalene, ammonium carbonate, zinc valerianate, and a number of flowers, herbs, and spices behave in the same way, nothing but gases or vapours evaporating therefrom. W. H. Sı.

2142. *Effect of Change of Temperature on Weight.* **J. H. Poynting** and **P. Phillips.** (Roy. Soc., Proc. Ser. A. 76. pp. 445–457, Sept. 13, 1905.)—Two equal brass cylinders, each weighing 266 gm., are suspended from the ends of the beam of a balance *in vacuo*, one of the weights hanging, by a long wire, near the bottom of a tube in which it can be heated or cooled. When the temperature of the latter weight is raised to 100° or lowered to —186°, the change of weight is deduced from the observed change in the centre of swing of a scale attached to the other weight. The working pressure was 1/50 mm. of mercury. Effects due to residual air are allowed for by finding the change in weight of hollow cylinders of the same size as the first, weighing 58 gm. In the result, a weight of 208 gm. does not change by more than 0·003 mgm. between 15° and 100°, and between 16° and —186° the change is not greater than 0·002 mgm., and it is concluded that between 15° and 100° change of weight is not greater than 1 in 10^9 for 1°; if there is any change of weight with change of temperature between 16·6° and —186° C., it is not so great as 1 in 10^{10} per 1° C. The net change found consisted in a loss of weight with rise of temperature. G. E. A.

2143. *Statistical Kinetic Equilibrium of Ether in Ponderable Matter at any Temperature.* **Kelvin.** (Phil. Mag. 10. pp. 285–290, Sept., 1905. Paper read before the British Association at Cape Town.)—The subject is illustrated by experiments made at the National Physical Laboratory upon similar thermometers differently screened. Differences of 1° to 3·6° C. are found for the thermometers under black and white cloth exposed to direct sunshine.

J. W. P.

2144. *Diurnal Periods in the Lower Strata of the Atmosphere.* Parts II., III., and IV. **F. H. Bigelow.** (Monthly Weather Rev. 33. pp. 93–97, March; 132–137, April, and pp. 188–194, May, 1905.)—II. Diurnal Periods of the Barometric Pressure. III. Diurnal Periods of Vapour Tension Electric Potential, and Coefficient of Dissipation. IV. Diurnal Periods of the Terrestrial Magnetic Field and the Aperiodic Disturbances. In his International Cloud Report of 1898 the author discussed the relations between the waves of temperatures and of pressure in the lower atmosphere and the electric and magnetic fields of the atmosphere, but the temperature variations with the height and the streams of ions could not then be allowed for. These papers supplement those investigations. It is now clear that the solar energy cannot build up temperature and dynamic waves in the upper strata. The first paper deals with the diurnal, semi-diurnal, and tri-diurnal temperature waves in their bearing upon the pressure. The second paper takes the hourly vapour tension values from Parc St. Maur, and transfers them to the 195-, 450-, and 1,000-m. levels at Blue Hill. The author rejects the various hypotheses as to the electric currents in the atmosphere, because any such currents in the upper strata could not account for the strongly localised magnetic effects on the earth's surface, and he bases his views on the assumption that the surface charge of negative ions rests steadily on or within the earth, while the positive ions would rise and fall from one atmospheric stratum to the other according to the changes in the air temperature. He considers magnetic vectors as the effect of the diurnal temperature waves upon the redistribution of the positive ions in the lower strata, and gives a series of vector charts for the different zones of the earth. Aperiodic disturbances are also dealt with. [See also Abstract No. 1695 (1905).] H. B.

2145. *Relation between Geology and Seismic Action.* **S. Kusakabe.** (Mathematical and Physical Soc., Tokyo, 2. 25. pp. 395–404, 1905.)—The author [see Abstract No. 2467 (1904)] has arrived at two main propositions, and dwells on their consequences. The propositions are: (1) At any time t, the frequency, F, of after-shocks is given by three equations: $F = F_1 - F_2$; $F_1 = h/(t + \tau)$; $F_2 = (h/T) \log [1 + T/(t + \tau)]$, where h is a complex constant, τ a constant referring to the choice of the origin of time t, and T the time required for accumulating maximum stress. (2) The seismic wave conductivity has different values for different rocks; the iso-frequency curves swell out where palæozoic, or better archæan, rocks predominate, and shrink where cainozoic rocks prevail. The first proposition concerns the frequency of after-shocks at the centre of origin of a given earthquake, the second cases where the seismic centre is outside the region considered. The surface intensity is not a measure of what takes place below; it may increase abruptly when the waves pass from older, more elastic rocks into more recent rocks, and this imperfectness of the elastic properties is the prime cause of after-shocks, or rather earthquakes. The after-shocks do not necessarily proceed from the forces of the original earthquake; in fact, this is rarely so. To elucidate that we have always to consider the surroundings of any affected region. The author refers to thermal relations. Two copper and two lead strips are placed by the side of one another in the order Cu_1 Pb_1 Cu_2 Pb_2, and Cu_2 is heated at a point P; although Cu_1 may be as near P as Pb_2, it will only become slightly heated because Pb_1 conducts badly. If two spots are shaken it does not follow that the ground between the two was shaken. The conclusions are: (1) Any extensive district geologically uniform cannot participate in earthquakes originating in its surroundings except at the boundaries. (2) A district of archæan formation feels no earthquake except that of its own origin, and is therefore stable, though it may be an epicentre of a strong earthquake. (3) A cainozoic district is very unstable, as it participates in its own and in neighbouring earthquakes. (4) An archæan earthquake lying in an extensive cainozoic plain would be stable. (5) A small cainozoic district within an archæan region is most unstable. (6) The propagation of earthquakes is irreversible; the New Madrid earthquake of 1886 was felt at Charleston, but a Charleston earthquake need not be felt at New Madrid. These conclusions are illustrated by references to Japanese earthquakes and to the researches of Omori and Koto. H. B.

2146. *Oscillations of Solar Activity and Climate.* **C. Easton.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 68–78, July 14, 1905. Proc. 8. pp. 155–165, Aug. 17, 1905.)—Continuing from his previous communication [see Abstract No. 683 (1905)], with the supposition that the 11-year oscillation of temperature with regard to the 11-year cycle of the sun's activity generally was accelerated in the cold, and retarded in the warm part of the larger oscillation, the hot and cold factors are further manipulated with regard to the maxima and minima of the spot cycle. Evidence is brought to show the existence of an 89-year period, but strong deviations occur from this period both in the spot cycle and the climate. C. P. B.

2147. *Ultra-violet Spectrum of Reversing Layer.* **H. Deslandres.** (Comptes Rendus, 141. pp. 409–414, Aug. 28, 1905.)—During the total solar eclipse of May 28, 1900, two ultra-violet spectrographs were employed in the hope of recording the spectrum of the reversing layer as far as λ3000. Their focal lengths were 0·5 and 1·0 m. respectively, the objectives being composed of achromatic combinations of quartz and fluorspar; the prisms, having an angle of 60°, were of Iceland spar, with their edges cut parallel to the optical axis of the crystal. These were so arranged that the same pneumatic release would operate exposing shutters for both, and the proper instant was chosen by visually examining the diminishing crescent of the sun with a direct-vision spectroscope. The resulting spectra showed detail from λ5000 to λ3000, the larger having a length of 11 cm. and the smaller 5·5 cm. between these limits. A preliminary reduction of the wave-lengths of the chief lines photographed confirms previous work in ascribing the most important origins to titanium, vanadium, chromium, and scandium, as found in the spark spectra of these elements. Tables are given showing the comparison between flash lines, dark Fraunhofer lines, and spark lines of the above-mentioned elements. C. P. B.

2148. *New Method for Determining the Solar Constant.* **Ceraski.** (Nature, 72. p. 437, Aug. 31, 1905. From Astronom. Nachr. No. 4037.)—By the introduction of a systematic series of photometric determinations of the light of the telescopic planets, the author hopes that it will be possible to eliminate the effect of the absorption of our atmosphere on the measures of variations in the solar radiation. If this latter change is of sufficiently great amount, it should be indicated by the light reflected by the planets, and a long period of regular photometric measurements should show the required change independent of terrestrial absorption. C. P. B.

2149. *Density of Algol Variables.* **J. H. Jeans.** (Astrophys. Journ. 22. pp. 93–102, Sept., 1905.)—The density as usually derived from the angular velocity of the system is so small that the hypothesis of an incompressible fluid becomes untenable. The configurations of equilibrium for rotating incompressible fluid systems are investigated, and the bearing upon the origin of double stars is considered. The result is that the stars must be nebulous and not liquid in their origin. The great importance of gravitational instability as a factor in cosmic evolution is pointed out. J. W. P.

2150. *Polarisation of Solar Corona, August* 30, 1905. **G. Meslin.** (Comptes Rendus, 141. pp. 493–496, Sept. 11, 1905.)—The author was stationed at Burgos. For measuring the proportion of polarised light, a Cornu photopolarimeter was adapted to the end of an astronomical telescope provided with means of directing it to the proper region. The first minute of totality was devoted to this work, and it was found that the proportion of polarised light was sensibly the same in both polar and equatorial regions, being about 50 per cent.; this value is about equal to that given by Landerer for a region situated in the ecliptic several seconds from the sun's edge. This high proportion of polarised light appears to indicate that a part at least of the light which comes to us from the corona is due or subject to reflection or refraction. The second branch of research dealt with the measurement of the ellipticity of the polarisation, using an astronomical telescope in the eyepiece of which was placed a Bravais polariscope, this latter, however, being modified to suit the fact that the chief part of the coronal light is known to be in the green. For this the ordinary biplate was replaced by one more sensible to changes in a homogeneous pencil of rays, having a thickness corresponding to two wave-lengths of sodium light. With this apparatus observations were made at the polar and equatorial zones, and at an azimuth of 45°, giving the nicol the two principal orientations. In no case was any elliptic polarisation detected, and this was also the result of trying the ordinary biplate, which was substituted for the special one just before the third contact. It is evident, then, that the observed reflections have not the character of metallic reflection, nor are the refractions produced by double-refracting layers. **Piltschikoff.** (Ibid. 141. pp. 472–473, Sept. 4, 1905.)—Piltschikoff has shown previously that the proportion of polarised light measured at 10° from either the sun or the moon is practically the same, notwithstanding the enormous difference of intensity in the direct radiation in each case. In this connection it was considered important to measure the atmospheric polarisation during the recent total solar eclipse, and this was done with a Cornu photopolarimeter. At 10° from the sun the polarisation was 62 per cent. for the blue, and from 57 to 58 per cent. for the red. At the instant of totality there was a doubtful observation giving zero polarisation for the blue. C. P. B.

2151. *Polarisation of Solar Corona of August* 30, 1905. **J. J. Landerer.** (Comptes Rendus, 141. pp. 589–590, Oct. 9, 1905.)—The author observed the recent eclipse from a station at Alcosebre, in Spain, the sky being perfectly clear for first contact and the total phase. He employed an optical system consisting of an astrophotographic objective of 7·5 cm. diam. and 88 cm. focus, and a Wollaston prism of 6·2 cm., fitted to a dark chamber carried on an equatorial stand. The principal sections of the doubly-refracting prism were oriented, roughly speaking, in the direction predicted for the St. Andrew's cross formed by the coronal wings, or at nearly 45° to the vertical, which at Alcosebre coincides to within 4° with the sun's axis. In view of the large amount of polarised light in the corona of 1900, it was expected that traces would be found from about the middle of the inner corona, but polarisation only began outside this middle region, and attained its maximum well within the outer corona. On the six photographs taken during totality, with exposures of 4, 5, and 6 sec., the two images of the moon's disc appear surrounded by a luminous aureole having at its base uniform intensity all round the circumference, the action of the Wollaston first becoming clearly evident in the outer portion of the inner corona. The proportion of polarised light measured on the plates by means of a scale of 10 intensities, 0 representing natural light and 10 light completely polarised, was between 0·5 and 0·6—a value scarcely differing from that obtained in 1900. The apparatus employed, though less delicate than Cornu's photopolarimeter, gives results correct to within about 1/10. The period of totality was comparatively light on the earth, the corona as a whole being remarkably bright. The general brightness and the absence of polarisation in the lower regions are both attributed by the author to the profound modifications at work in the coronal masses during the maximum epoch of solar activity. A. E.

REFERENCES.

2152. *Cavitation in Lubrication.* **S. Skinner.** (Phys. Soc., Proc. 19. pp. 73–80; Discussion, pp. 80–81, May, 1904.)—The experimental method of observing cavitation by means of Newton's ring is described.

2153. *Rotary Mercury Pump.* **W. Gaede.** (Phys. Zeitschr. 6. pp. 758–760, Nov. 9, 1905. Naturforscherversamml. at Meran, Sept. 24–30, 1905.)—The pump described and illustrated is capable of evacuating a 6½-litre space from an initial pressure of 9 mm. down to 0·03 mm. in 5 min., to 0·0018 mm. in 10 min., 0·0001 mm. in 20 min., and 0·00007 mm. in 30 min., as shown by a 300-c.cm. McLeod gauge.

L. H. W.

2154. *Formation of Ice and the Grained Structure of Glaciers.* **G. Quincke.** (Roy. Soc., Proc. Ser. A. 76. pp. 431–439, Sept. 13, 1905. Nature, 72. pp. 543–545, Sept. 28, 1905. Ann. d. Physik, 18. 1. pp. 1–80, Oct. 12, 1905.)—The results of a searching examination as to the minute structure of glaciers. The various surface tensions of the liquids present before the ice is formed, the presence of emulsions, foam, foam cells, and salts in solution are all held to play a part in the grained structure of glaciers. Some of the results are due to imitative experiments, and others to examinations by the naked eye, microscope, and polarised light.

E. H. B.

2155. *Sliding Friction.* **P. Painlevé.** (Comptes Rendus, 141. pp. 401–405, Aug. 21, and pp. 546–552, Oct. 2, 1905.)—A continuation with mathematical considerations of the work of Abstract No. 952 (1905). In the first paper two cases of unilateral and one of bilateral connection are considered. Various objections are then dealt with, and the result, that there is a logical contradiction under realisable conditions between the laws of Coulomb and those of rigid dynamics, is reaffirmed. —**de Sparre.** (Ibid. pp. 310–312, July 31.) J. W. P.

2156. *Elastic Constants of Steel and Cast Iron.* **O. Wagner.** (Beibl. Ann. d. Physik, 28. 20. p. 1051, 1904. Extract of Dissertation, Jena, 1903.)—The "elasticity ratio" μ, the ratio of contraction in area to elongation, was determined by Cornu's method of flexure. The apparatus employed was a slight modification of that of Straubel [see Abstract No. 1620 (1899)], but the measurements were in the present instance made directly on the interference image. The values for μ lie between 0·22 and 0·28. No dependence of the value of μ on the carbon content and the value of the elastic modulus was traceable. L. H. W.

2157. *Action of Capped Armour-piercing Shell.* **E. K. v. Thurnwerth.** (Eng. News, 54. pp. 346–348, Oct. 5, 1905. Mech. Eng. 16. pp. 627–631, Oct. 28, 1905. From Mitteil. a. d. Gebiete d. Seewesens, 33. 2, 1905.)—Current theories of the action of capped shell are discussed, and the author offers a mechanical explanation—the cap starts the formation of a "material cone" (Kicks) in the plate, and the point of the projectile is able to commence its penetration uninjured. Methods of attachment and forms of cap are described. The minimum velocity at which capped shell is more effective than uncapped is taken as about 1,650 ft. per. sec. F. R.

2158. *Verification of Barometric Altitudes of Ballons Sondes by Theodolite Observations.* **L. Teisserenc de Bort.** (Comptes Rendus, 141. pp. 153–155, July 10, 1905.)—So far as atmospheric conditions permit—for instance, in sixty cases out of the thousand ascents in two years—the trajectories of the ballons sondes are at Trappes ascertained with the aid of theodolites. A comparison of the two series of altitudes shows discrepancies of ± 1/50 of the total altitude. This may be due to imperfections of the barometers and to inaccuracies of the theoretical pressure gradient. The author reproduces the theodolite and barometer curves of one ascent and descent, which indicate a marked sluggishness of the barometer. H. B.

2159. *Constant of Aberration.* **H. Renan** and **W. Ebert.** (Comptes Rendus, 140. pp. 1669–1672, June 26, 1905.)—The authors outline a delicate method for determining the constant of aberration by means of observations on three stars in the neighbourhood of the Poles. The deduced value is $\nu = 20{\cdot}434'' \pm 0.030''$.

C. P. B.

2160. *Seismology in the Antarctic Regions.* **J. Milne.** (Roy. Soc., Proc. Ser. A. 76. pp. 284–295, July 10, 1905.)—Preliminary notes are given of a long series of observations made during the voyage of the *Discovery* with the horizontal pendulum apparatus at 38 widely separated stations. Part of the time the instrument was installed in the same hut as the magnetometers, and again in a room about 15 miles from the constantly active volcano Mount Erebus. The records obtained refer to changes in the vertical, tremors, pulsations, and earthquakes. C. P. B.

2161. *Nova Aquilæ.* (Nature, 72. p. 465, Sept. 7, 1905.)—Telegraphic announcement received from the Harvard College Observatory, stating that Mrs. Fleming had discovered a new star on Aug. 12, from an examination of the photographic charts of the sky taken there. Its position was as follows: RA. = 18h. 57m. 8s.; Decl. = −4° 34′; Equinox 1900. The Nova was then fading rapidly. It was situated near λ Aquilæ. C. P. B.

2162. *Spectroscopic Determinations of Sun's Rotation.* **J. Halm.** (Astrophys. Journ. 22. pp. 150–153, Sept., 1905.)—Replies to criticisms of the method adopted by the author in determining the sun's rotation spectroscopically, where he used a heliometer objective for obtaining the comparison of the opposite limbs. He shows that the difference of illumination of the collimator objective by the two halves of the heliometer was not unforeseen, but was distinctly allowed for and satisfactorily eliminated. C. P. B.

2163. *Orbit of Spectroscopic Binary ζ Tauri.* **W. S. Adams.** (Astrophys. Journ. 22. pp. 115–118, Sept., 1905.)—Determinations of the orbit have been made from 25 plates of the spectrum of the star taken at the Yerkes Observatory from Feb 12, 1902, to March 24, 1905. From the results the value of 138 days was finally decided upon. No trace of the spectrum of the second component has been found upon any of the plates, the evidence afforded by the remarkably well-defined character of $H\gamma$ being especially conclusive. C. P. B.

LIGHT.

2164. *Diffraction Grating Replicas.* **R. J. Wallace.** (Astrophys. Journ. 22. pp. 123–130, Sept., 1905.)—A solution of best guncotton in amylacetate is poured into water, and the precipitated cotton dissolved in more amylacetate. This solution is poured over the grating in a thin film and allowed to dry. It is then stripped and mounted. This method gives most excellent results, there being no air-bubbles such as occur with the Thorp celluloid grating. E. C. C. B.

2165. *Mirror Method for Small Deflections.* **E. Preuss.** (Elektrotechn. Zeitschr. 26. pp. 411–413, April 27, 1905.)—The author advocates an extension of the telescope-and-scale method of reading small galvanometer deflections. The scale is replaced by a concave or convex mirror, which receives the image of a scale placed under (or above) the galvanometer. A greatly enlarged reading in the telescope is obtained for a given small angular displacement of the galvanometer mirror. The method may also be employed when working with a spot of light. The theory of the method, with the conditions necessary for obtaining a proportional scale, is worked out; and the factor of magnification is given. The method is especially adapted to zero working. D. K. M.

2166. *Method of Adjusting a Telescope to Point Horizontally.* **F. Biske.** [Notice by Hammer.] (Zeitschr. Instrumentenk. 25. p. 319, Oct., 1905. From Bull. Astronomique, 21. p. 457, 1904.)—The method depends on the principle that a ray of light doubly reflected at two planes at right angles remains parallel to its original direction. The telescope is directed to the surface, Q, of the mercury in a trough, and a perfectly plane mirror, S, is placed at right angles to Q and facing the telescope. Let 1 be the central ray from the cross-wires of the telescope, 2 a ray parallel to 1 after passing through the objective, 1′, 2′ the paths of the same rays after double reflection at mercury and mirror. Then, if S is truly vertical, 1 2 1′ 2′ will all be parallel, and the cross-wires and their image will coincide. But if S is inclined at an angle a to the vertical, this will no longer be the case (though 1 will be parallel to 1′, and 2 to 2′), and the image will be displaced up or down by an amount $2a$. Hence the first step is to adjust the mirror, S, for verticality, as shown by sharp coincidence of the wires and their image by double reflection, the accuracy being twice as great as for an image by single reflection. The telescope is then directed at the vertical mirror and after autocollimation of the cross-wires in the mirror the telescope will be pointing horizontally. The illumination of the wires must be strong. A. E.

2167. *The Latent Photographic Image.* **J. Joly.** (Nature, 72. pp. 308–310, July 27, 1905. Address to Photographic Convention, 1905.)—It is argued from Dewar's result that the photographic plate retains considerable power of forming the latent image at temperatures near the absolute zero, that the fundamental effects progressing in the film under the stimulus of light-waves must be regarded as other than those of a purely chemical nature, and we must turn for guidance to some purely photo-physical effect. Bose would refer the formation of the image to a strain of the bromide of silver molecule under the electric force in the light-wave. But, from a test of the photosensibility of aluminium and of silver bromide at temperatures near that of liquid air, and from other evidence, the hypothesis is suggested that the beginnings of photographic action involve an electronic discharge from the light-sensitive molecule; in other words, the latent image is built up of ionised atoms or molecules upon which the chemical effects of the developer are subsequently directed. This appears to explain the outstanding photographic sensitiveness of the film at temperatures far below those at which chemical actions in general cease, and there is nothing in Wood's experiments on photographic reversal opposed to the photo-electric origin of photographic effects. No electronic discharge, however, has yet been detected from the film under light stimulus. G. E. A.

2168. *Distribution of Energy in the Visible Spectrum.* **E. L. Nichols.** (Phys. Rev. 21. pp. 147–165, Sept., 1905.)—A computation of the distribution of energy in the visible spectrum of the light from various sources. The energy curves for the Hefner lamp and the acetylene flame have previously been measured, and a spectrophotometric comparison between these two has shown the possibility of determining the energy curve of an unknown source by simple photometrical comparison with one of these standards. The author has done this for several different sources, and the results are given and discussed in the paper. E. C. C. B.

2169. *Colour-photograph Negative by Transmission.* **G. Lippmann.** (Journ. de Physique, 4. pp. 560–561, Aug., 1905.)—In the Lippmann process, when the sensitive coating used is a bichromated one, it is fixed by simply washing with water. The colours appear at the same time and disappear on drying. If an aqueous solution of KI is substituted for the water, the colours remain visible but feeble. If the plate be now washed in a 20 per cent. solution of $AgNO_3$ the colours become extremely brilliant, and remain so even after washing and drying. The colours seen by transmission are complementary to these and give a brilliant negative. G. E. A.

2170. *Superposition of Stationary Waves of Different Period.* **H. Lehmann.** (Phys. Zeitschr. 6. pp. 553–556, Sept. 1, 1905. Phys. Inst. d. tech. Hochschule, München, Aug., 1905.)—In explaining the photographic reproduction, by the Lippmann process, of a mixed colour, the author starts from the density distribution of the silver deposit which results from the action of two or more superposed stationary waves of different period, and finds a density curve which shows that the density distribution for a heterogeneous ray is periodic. The theory is tested by means of fine microtome sections of "grainless" plates on which spectral and mixed colours had been taken, and the wave distribution of density required by the theory is recognised in the preparations. In one preparation about 40 such wave-lamellæ at distances of 1 μ were counted, and between the consecutive lamellæ were seen a number of finer ones corresponding to the half wave-lengths of the colours used. The preparations in addition form good test objects for the microscope. G. E. A.

2171. *New Calculation of an Aplanatic Lens.* **W. Pscheidl.** (Phys. Zeitschr. 6. pp. 511–513, Aug, 15, 1905.)—A calculation is made to find the form of a lens surface such that a ray from the focus passes through the lens parallel to the axis and emerges unrefracted at the second surface. The form found is a plano-convex, the curved surface being a hyperboloid of revolution. Descartes' proof is also given, and it is mentioned that Descartes described a machine for grinding such lenses.—**J. Petri.** (Ibid. pp. 632–633, Oct. 1, 1905.)—Petri points out that besides the convex lens mentioned by Pscheidl, the plano-concave lens, of which the curved face is part of an ellipsoid of revolution, may also be shown to be aplanatic for heat- and light-rays. It is further shown that the necessary condition for aplanaticity is: refractive index = semi-axis/eccentricity in the case of the ellipse, and eccentricity/semi-axis in that of the hyperbola. G. E. A.

2172. *Ellipsoidal Lenses.* **R. J. Sowter.** (Phys. Soc., Proc. 19. pp. 631–634; Discussion, pp. 634–635, Oct., 1905. Phil. Mag. 10. pp. 180–183, July, 1905.)—This note extends the treatment of thin ellipsoidal or astigmatic lenses by the author's method [see Abstract No. 782 (1901)], and gives a simple solution for problems of the following types: "To determine the astigmatic pencil, after refraction of an astigmatic pencil by an ellipsoidal lens," and "to find the ellipsoidal lens equivalent to two cylindrical lenses placed a definite distance apart, with their axes inclined at any angle." The method can be applied to crossed ellipsoidal lenses in contact or separated. It has been shown by S. P. Thompson [see Abstract No. 1414 (1900)], and the author, that for obliquely-crossed cylindrical lenses an important parallelogram of powers can be constructed. This parallelogram is associated with the resolution of a lens-power P into the two powers $P\cos^2\theta$, $P\sin^2\theta$, at right angles. It is here generalised. If an astigmatic pencil having two focal lines at distances 1/U, 1/V, from an ellipsoidal lens of focal powers A, B, is refracted by the lens, which is further defined in position with respect to the focal lines by θ [$=\widehat{AU}$], then by resolving along two directions at right angles and adopting the curvature notation, we get—

$$-(U\cos^2\theta + V\sin^2\theta) + U'\cos^2\theta' + V'\sin^2\theta' = A \text{ ....(i.)}$$

$$-(U\sin^2\theta + V\cos^2\theta) + U'\sin^2\theta' + V'\cos^2\theta' = B \text{ ....(ii.)}$$

the dashed letters referring to the refracted pencil. These equations give—

$$-(U + V) + U' + V' = A + B \text{ .... (I.)}$$

$$-(U - V)\cos 2\theta + (U' - V')\cos 2\theta' = A - B \text{ ......(II.)}$$

This last equation shows that the power parallelogram has its sides equal to (U − V), (A − B), its angle 2θ, its diagonal (U′ − V′), and the inclination of the diagonal to the side (A − B), $2\theta'$ The parallelogram affords the equation—

$$(U' - V')/(U - V) = \sin 2\theta/\sin 2\theta' \text{ .... (III.)}$$

Equations I., II., III. give a complete solution. The usual signs are to be adopted, such as to make $-(U + V) + V' + V' = A + B$. The case where a parallel pencil falls upon the first lens of a crossed and separated cylindrical combination is then considered. The above method can only be applied to astigmatic problems in which the wave-fronts after refraction are paraboloidal, or are ellipsoidal and can be assumed paraboloidal in the neighbourhood of some point. A. E.

2173. *Remark on the Theory of Conical Refraction.* **W. Voigt.** (Phys. Zeitschr. 6. pp. 672–673, Oct. 15, and pp. 818–820, Dec. 1, 1905.)—A curious point is raised in this paper. If the phenomenon of internal conical refraction be observed with a sufficiently small pencil of light, a fine dark ring may be seen dividing the bright ring, usually regarded as the effect of conical refraction, into two parts nearly equal in breadth. Paradoxical as the statement may at first sight appear, it is this dark ring which really represents the phenomenon, and not the bright rings. The following is the explanation. Of all the rays in the incident pencil only one fulfils the condition necessary for conical refraction, of being parallel to the optic axis. This one ray, being nearly a mathematical line, contains an evanescent amount of light, and when this small amount is, by conical refraction, spread over a cone, each element of the cone receives an indefinitely small contribution, and the result is practically darkness. The phenomenon being of an abruptly discontinuous nature, rays differing in direction from the optic axis, even by a very small amount, will not be conically refracted, but will give only the usual pair of images, ordinary and extraordinary. The bright rings seen on either side of the fine black ring are not results of conical refraction at all, but merely assemblages, one of the ordinary, the other of the extraordinary, images due to rays surrounding the ray parallel to the optic axis. The dark line was first observed by Poggendorff [Pogg. Ann. 48. p. 461, 1839]. Haidinger was puzzled by it sixteen years later, and then it seems to have fallen into oblivion. The above remarks, as will readily be seen, do not apply to the case of external conical refraction where the conditions under the ordinary method of observing are different. A. E.

2174. *Refractive Indices of Sulphuric Acid at Different Concentrations.* **V. H. Veley** and **J. J. Manley.** (Roy. Soc., Proc. Ser. A. 76. pp. 469–487, Sept. 18, 1905.)—The refractive indices of sulphuric acid of concentrations varying from 1 to 99 per cent. were determined for the wave-lengths $\lambda = 6563$, $\lambda = 5893$, $\lambda = 4861$, and $\lambda = 4340$. Every precaution was taken to guard against errors. All the values have been reduced to 15°, which was rendered possible by a determination of the temperature coefficients. The indices pass through a maximum at a point nearly corresponding to the hydrate H_2SO_4, H_2O. The indices, the constants of Cauchy's formula, and the Lorentz factor, $(\mu^2 - 1)/(\mu^2 + 2)d$, all show irregularities for concentrations between 92 and 100 per cent., which are consistent among themselves. The authors conclude that the substance H_2SO_4 does not exist as a separate entity.

E. C. C. B.

2175. *Refractive Index of Gaseous Fluorine.* **C. Cuthbertson** and **E. B. R. Prideaux.** (Roy. Soc., Phil. Trans. 205. pp. 319–331, Oct. 19, 1905. Roy. Soc., Proc. Ser. A, 76. pp. 426–427, Sept. 13, 1905. Abstract.)—After several preliminary series of experiments the refractivity of fluorine was successfully determined as follows: The gas was prepared by the electrolysis of hydrochloric acid in a copper U-tube, and purified from traces of the acid by being passed through tubes cooled to −78°; any traces of ozone were decomposed by passing the gas through a spiral heated to from 250° to 300°. The fluorine was then passed into the Pt-Ir refractometer tube, 45·78 cm. long and 0·65 cm. diam. The ends of this tube were made of fluorite, so that the fluorine after leaving the electrolysis tube only came into contact with platinum and fluorspar. The number of interference bands crossing the field during the filling of the refractometer tube were counted, and then the gas in the tube was analysed. The fluorine was absorbed by metallic lead, the reduction of pressure being observed on a mercury manometer. As the volume of the tubes was known the total amount of fluorine present was easily found. The oxygen and nitrogen in the residual gas were estimated, and the refractivity of fluorine deduced from that of the mixture. Four experiments gave $\mu - 1 = 195, 192, 194$, and $198{\cdot}5$, which corresponds to a mean index of 1·000195. Cuthbertson recently pointed out some very interesting relations between the refractivities of the elements of the same group in the periodic table [see Abstract No. 337 (1905)]. The above value for fluorine brings it into line with Cuthbertson's relation, as is shown by the following table of refractivities :—

			He 139 × ½
N 297 × 1	O 270 × 1	F 192 × 1	Ne 139 × 1
P 297 × 4	S 270 × 4	Cl 192 × 4	A 139 × 4
		Br 192 × 6	Kr 139 × 6
		I 192 × 10	X 139 × 10

E. C. C. B.

2176. *Ether "Drift" and Rotary Polarisation.* **D. B. Brace.** (Phil. Mag. 10. pp. 383–396, Sept., 1905.)—Mascart, some thirty-five years ago, first examined the effect of the motion of the earth on double circular refraction, using R- and L-quartz, from which he concluded that the rotary power of quartz is not altered by the one twenty-thousandth part when the ray is *reversed* in the direction of motion of the earth. Rayleigh recently repeated this experiment, also using quartz, in which he found that such a reversal does not alter the rotation by one hundred-thousandth part. The present author, by using an active oil, the oil of caraway, and reversing the ray so as to compensate for rotary dispersion, has been able to carry the limit 25 or 50 times as far. He thus asserts that the effect of the motion of the earth on the rotation in active substances is certainly less than one five-millionth, and probably less than one ten-millionth, of the total rotation. [See Abstract No. 889 (1903).]

E. H. B.

2177. *Magneto-optics of Sodium Vapour and the Rotatory Dispersion Formula.* **R. W. Wood.** (Phil. Mag. 10. pp. 408–427, Oct., 1905. Communicated by the Physical Society.)—In this paper the author describes a series of more accurate observations of the magnetic rotation of sodium vapour than was possible with his previous apparatus [see Abstract No. 1730 (1905)]. Steel tubes with glass ends were employed to contain the sodium vapour, and the spectrum was obtained by means of either a 14-ft. focus grating or large plane grating and objectives of 6-ft. focus, according to the illumination. In the rotation formula $\delta = (1/n)[a/\lambda^2 + b\lambda^2/(\lambda^2 - \lambda_m^2)^2]$, n differs so little from unity in the case of sodium vapour that it may be left out of account ; furthermore $a = 0$, so that the term a/λ^2 drops out. The values calculated agree very well with those observed on the one side of the D lines, but the agreement on the other side is very poor. This results from the fact that the rotatory power of the two lines is different, and the following formula was adopted : $\delta = a\lambda^2/(\lambda^2 - \lambda_{D_2}^2)^2 + b\lambda^2/(\lambda^2 - \lambda_{D_1}^2)^2$. This formula gives extremely good values for rotations outside the D lines, but is not so satisfactory for those between the D lines, the calculated values being too low. In the case of very dense vapours the single-term formula given above represents the rotation extremely well. In the second part of the paper the author deals with the bright-line rotation spectrum in the red and green. The wave-lengths of the lines are given. E. C. C. B.

2178. *Chromatic Depolarisation of Light by Diffusion.* **N. Umow.** (Phys. Zeitschr. 6. pp. 674–676, Oct. 15, 1905. Phys. Inst. d. Univ., Moskau, Sept., 1905.)—The author describes experiments conducted to ascertain the different character of the light diffused by various dull surfaces when a polarised beam is allowed to fall upon them. He finds that in the diffused light there is always selective depolarisation of those rays to which the substance is most transparent. A black body is usually defined as one, of which an infinitely thin layer completely absorbs all light falling upon it. It possesses, however, another equally characteristic property, namely, that of introducing regularity into the vibrations of the incident light. Thus a pencil of natural light becomes polarised by diffusion from a black substance, a polarised beam remaining polarised. Perfectly black bodies are not met with in practice, so the author, extending the use of the word, speaks of a substance as black for certain rays, those which it absorbs, and not black for others. If a polarised pencil falls upon a dull surface of any substance, those rays only will remain polarised after diffusion, for which the substance is black. In the case of a white substance, a very thin layer does not completely absorb the incident light, part of which, therefore, penetrates the interior and is diffused therefrom. This process is accompanied by depolarisation, so that a white body, in contrast to a black body, may be said to produce irregularity in the vibrations of the incident light. The observations confirm the inference that a coloured body depolarises the rays which form its characteristic colour, these rays suffering least absorption, and therefore traversing a greater portion of the substance. The difference in behaviour of a black and a white body, as regards diffusion of polarised light, can be shown by any of the ordinary apparatus for producing colours in polarised light. It is sufficient to substitute for the analyser a black or white cloth, paper, &c. The black surface will show colours, the white will not. A black body acts as an analyser. The author employed the following arrangement: The glowing wire of a Nernst lamp was projected on the dull plane surface of the body under examination, which was mounted on the alhidade of a divided circle, so that the angle of incidence could be regulated. In the path of the rays, between lamp and body, stood a nicol, and a direct-vision prism which spread the image on the surface into a spectrum. The light after diffusion traversed a pile of twelve glass plates, whose inclination could be altered, and then fell on a Savart polariscope, whose bands could be examined with a small telescope having a nicol in the eyepiece. The substances examined were thin sheets pressed in a hydraulic press, filter papers, cards, powders, &c., of known chemical constitution. A. E.

2179. *Spectra of Alloys.* **P. G. Nutting.** (Astrophys. Journ. 22. pp. 131–137, Sept., 1905.)—A series of spectrographic observations upon the spectra of certain alloys under varying conditions. It is found that in the case of both arc and spark the spectra of the component metals are quite independent of one another, and that varying the conditions does not alter the relative intensities of the spectra of the components. In both arc and spark with self-induction the spectrum of the component of greater atomic weight will be brighter. The author as a result of his investigations concludes that a rough spectroscopic quantitative analysis (within 5 per cent.) would be possible under certain conditions, namely, that (1) selected lines are used for comparison ; (2) the current is strong enough to volatilise plenty of metallic vapour ; (3) allowance is made for the different character of the spectra of pure metals, and for the atomic weights if these differ by a considerable amount. E. C. C. B.

2180. *Wave-lengths of Certain Silicon Lines.* **E. B. Frost** and **J. A. Brown.** (Astrophys. Journ. 22. pp. 157–160, Sept., 1905.)—The wave-lengths of the three silicon lines at λ = 4553, 4568, and 4575 are of especial utility in measuring the radial velocity of stars of the Orion type. They have been redetermined with great care, using a 10-ft. grating ; the final results are given as λ = 4552·64, λ = 4567·90, and λ = 4574·79. The values used previously were those of Exner and Haschek, and the change to the new wave-lengths when expressed in km. per sec. in radial velocity is as follows :—

	Correction.
λ = 4553	— 0·114 t.m. = — 7·51 km.
λ = 4568	— 0·053 t.m. = — 3·48 km.
λ = 4575	— 0·109 t.m. = — 7·14 km.

E. C. C. B.

2181. *Absorption Spectrum and Fluorescence of Mercury Vapour.* **W. N. Hartley.** (Roy. Soc., Proc. Ser. A. 76. pp. 428–430, Sept. 13, 1905. Chem. News, 92. p. 102, Sept. 1, 1905.)—The absorption spectrum of a column of mercury vapour 37 mm. long was observed, the pressure of the vapour being 847 mm. and the temperature about 360°. A very sharply defined and intense absorption band, somewhat degraded on the side towards the red, was observed between λ = 2571·67 to λ = 2526·8. When the mercury was boiling, the whole of the flask nearest to the spark was lighted up with a green fluorescence. When all the mercury had been converted to vapour, the fluorescence ceased. There appears to be an upper and lower limit of temperature between which fluorescence takes place. The above absorption band is characteristic of the vapour of mercury, for it is not exhibited by mercuric chloride in aqueous solution. [The fluorescence or phosphorescence of mercury vapour can readily be seen when mercury is boiled *in vacuo*.]

E. C. C. B.

2182. *Radiation from Metals.* **F. Streintz.** (Zeitschr. Elektrochem. 11. p. 772, Nov. 3, 1905. Paper read before the Versamml. Deutsch. Naturforscher and Aerzte in Meran, Sept. 24–30, 1905. Phys. Zeitschr. 6. pp. 764–768 ; Discussion, p. 768, Nov. 9, 1905.)—The metals Mg, Al, Zn, and Cd possess the peculiarity of producing an image of themselves, when in a bright condition, upon paper soaked in potassium iodide solution. A picture can be produced by Mg in 30 sec., by Al in 2min., while Zn and Cd require as many hours as Mg and Al minutes. The positive metals act also on the photographic plate. The metals in clean condition do not act in an atmosphere of carefully dried CO_2. It seems scarcely doubtful that it is the oxidation process brought on which produces the picture. On removing the metal to a distance from the sheet the action decreases considerably. The phenomenon has the character of a radiation, and should be designated as metallic radiation. The chemical process of oxidation would therefore be brought on by rays. The origin of the radiation should probably be sought in the electrolytic solution pressure. Through the solution pressure positive ions will be sent out in the neighbourhood of the metal. The surrounding air thus acquires a positive, the metal itself a negative, charge. The action will proceed more vigorously the greater the solution pressure, or, in other words, the more easily oxidisable the metal is. Through the impact of the metal ions, a volume ionisation of the air arises. Thus the silver salt of the photographic plate, or the potassium iodide solution of the paper, will be ionised. By the collisions within it, the air must be rendered conducting, and this conductivity can be shown by an electrostatic method. It appeared that the dissipation of the electricity of a magnesium condenser in dry CO_2 with small charge proceeded in exactly the same way as that of a copper-plate condenser in air. It seems as if magnesium, through the positive charge, had assumed the character of a nobler metal. Perhaps a metal can be protected from oxidation by a suitable positive charge.—**F. Streintz** and **O. Strohschneider.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 649–656, May, 1905. Ann. d. Physik, 18. 1. pp. 198–205, Oct. 12, 1905.)—An account is given of further investigations on the radiation from various metals [see Abstract No. 176 (1905)]. Instead of paper saturated with potassium iodide, the pictures produced on which are not permanent on account of the evaporation of the iodine, silver-bromide-gelatine photographic plates were used, and reproductions of the pictures obtained are given in the paper. The authors believe that the conclusion is correct that the intensity series of the pictures coincides with the electric tension series.

J. J. S.

2183. *Action of Radium on Gelatine Media.* **W. Ramsay.** (Science, 22. p. 405, Sept. 29, 1905. From "The Independent.")—A suggested explanation of the appearances observed by J. B. Burke [see Abstract No. 1399 (1905)]. Minute grains of solid radium bromide sprinkled on a gelatine broth medium would sink slowly below the surface, where they would dissolve in and decompose the water, liberating oxygen and hydrogen, together with emanations, which would remain mixed with these gases. The gases would form minute bubbles, probably of microscopic dimensions, and the coagulating action of the emanation on the albumen of the liquor would surround each with a skin, so that the product would appear like a cell; its contents, however, would be a mixture of the gases oxygen and hydrogen. The emanation, enclosed in such a sack, would still decompose water, for enough would diffuse through the moist walls of the sack. The accumulation of more gas would almost certainly burst the walls of the cell in one or two places. Through the cracks more gas would issue, carrying with it the emanation, and with it the property of coagulating the walls of a fresh cell. The result of the original bubble would resemble a yeast cell, and the second cell a bud, or perhaps more than one, if the original cell happened to burst. This process would necessarily be repeated as long as the radium continued to evolve emanation. The "life," therefore, would be a long one, and the "budding" would impress itself on an observer as equally continuous with that of a living organism.—**W. A. D. Rudge.** (Nature, 72. p. 631, Oct. 26, 1905.)—When radium barium bromide, and also when various barium salts which did not contain radium, were placed upon sterilised gelatine, effects were observed which resembled the growth of an ordinary mould. [See Abstract No. 1898 (1905).] J. J. S.

2184. *Penetrating Radiation.* **H. L. Cooke.** (Cambridge Phil. Soc., Proc. 13. pp. 160–164, Oct. 25, 1905.)—Experiments were made with the object of detecting and measuring, if possible, any penetrating radiation coming from the atmosphere. It was found that the penetrating radiation inside buildings is about 25 per cent. greater than that outside on the roof. When the ionisation vessel was on a lawn, and when suspended over the surface of a tank, the ionisation was approximately the same as on the roof. Submerging the apparatus to a considerable depth in a spring-water tank further reduces the leak by about 12 per cent., the reduction not being so great with the apparatus floating on the surface. The ionisation with the vessel buried about a foot in the ground does not differ greatly from the results on the roof. J. J. S.

2185. *Absorption by Zinc of the Emanation from Minerals.* **J. Munoz del Castillo.** (Real Acad. de Ciencias, Madrid, 2. 2. pp. 72^5–72^8, March, 1905.)—A small amount of a uraniferous mineral from Valencia de Alcantara was pulverised and placed on the photographic plate in the dark, a sheet of black paper being placed over the powder, and above this a ring of zinc 6 cm. diam. and 5 mm. thick, the powder being in the circular area within the metal ring. The exposure allowed was 35 days. On developing the plate it was noticed that (1) the active substance had produced an exceedingly feeble image, while (2) the activated zinc gave a much stronger image. The radiation effect of the latter is therefore greater than that of the mineral itself. A reproduction of the plate is given and this result discussed. The effect is considered to be due to absorption by the zinc, as was found by Hofmann, Gonder, and Wölfl for the ion-activation of other metals [see Abstract No. 3205 (1904)], the self-same radio-active element showing a different behaviour to different metals. L. H. W.

2186. *New Radio-active Salts.* **W. H. Martindale.** (Pharmaceut. Journ. 75. pp. 149–152, July 29, 1905. Paper read before the Brit. Pharmaceut. Conference, 1905.)—The author, after dealing generally with recent work in radio-activity, calls attention to the comparatively cheap radio-active uranium and thorium compounds, which he considers deserve more attention. The commercial thorium hydroxide is usually more active than the nitrate. A number of organic salts of thorium have been prepared by the author. The following list shows their relative radio-activity (time, in minutes, for electroscope leaf to fall three divisions of scale): Thorium lactate, 3½; hydroxide (moist), 5; paraphenylsulphonate, 6; salicylate, 7; oleate, 15; orthocoumarate, 15; acid urate, 16; cinnamate, 19 min. L. H. W.

2187. *The Scintillations produced by Radium.* **R. W. Wood.** (Phil. Mag. 10. pp. 427–430, Oct., 1905.).—Zinc sulphide is spread on the rim of a disc which can be rapidly rotated, and the scintillations produced by a small piece of radium situated above it are examined by means of a lens. At low speeds the flashes appear as points, but at the highest speeds they are drawn out into short lines, the duration of the flash being calculated to be between 1/15000 and 1/20000 sec. The luminescence caused by the crushing of the zinc sulphide crystals by pressing the point of a glass rod on the rim of the revolving dish is of much greater duration. Hence it is unlikely that Becquerel's hypothesis that the scintillations are due to the cleavage of the crystals is true. On the other hand, the duration of the flash makes it unlikely that each one is an impulse due to the impact of a positive electron. The author, by photographing the luminescence, finds that only a few of the zinc sulphide crystals scintillate; he thinks that the presence of some impurity may be the reason of the luminescence. He further suggests that the bombardment of the positive ions reduces the molecules to an unstable state, the flash being given out during the rearrangement of the constituents of the molecule. S. G. S.

2188. *New Apparatus for Determining Radio-activity of Spring-water.* **H. Sieveking** and **C. Engler.** (Archives des Sciences, 20. pp. 159–168, Sept., 1905. Phys. Zeitschr. 6. pp. 700–703, Oct. 26, 1905. Translation. Paper read before the Liége Congrés de Radiologie.)—A cylindrical vessel containing the water is surmounted by a conical cover carrying a metal-leaf electroscope. Inside the vessel another cylindrical vessel hangs by a wire from the electroscope, so that it is situated in the air immediately over the water to be examined. In using the apparatus a measured volume of water is poured into the vessel and vigorously shaken for half a minute; the electroscope and conductor are then fixed in position, the conductor charged, and the rate of fall of potential observed. The apparatus is standardised by finding the rate of electric leak when a litre of pure water is used instead of the spring-water. The advantage of the apparatus lies in its extreme simplicity and the ease with which it can be carried about and set up. S. G. S.

2189. *New Radio-active Element which evolves Thorium Emanation.* **O. Hahn.** (Ber. Deut. Chem. Gesell. 38. pp. 3371–3375, Oct. 21, 1905. Chem. News, 92. pp. 251–252, Dec. 1, 1905.) Communication from University College, London.)—The name radio-thorium is suggested for the new element, the properties of which have been described [see Abstracts Nos. 1398 and 1737 (1905)], and the further endeavours to obtain it in a more concentrated condition are detailed. The strongest preparation obtained consisted of about 10·9 mgm. of precipitate, giving about 700,000 times as much emanation as would be obtained from an equal weight of ordinary thorium (equivalent to 7½ kg. of Th of ordinary activity). The constancy of its activity distinguishes it from ThX. The emanation was more especially examined, and as the mean of a large number of measurements with various preparations of radio-thorium, it was found that the constant $\lambda = 1{\cdot}3 \times 10^{-2}$; the activity falls to half value in 53·3 sec. The values obtained for thorium emanation were 51·2 and 54 sec. In a dark-room the characteristic effects shown externally resemble those of actinium emanation, which are described. Strong heating of the preparation practically stops the emanation, but increases the direct effect on a screen, as was found by Rutherford with ordinary thorium. Immersion in liquid air produces the same effect as heating; the induced activity is stored up in the material, the total activity thus increased. Induced activity can be excited by radio-thorium. The induced activity is found to have a decay constant of $\lambda = 1{\cdot}82 \times 10^{-5}$; half value is obtained in 10·6 hours. The occurrence and behaviour of radio-thorium is such as leads one to consider the possibility that it is the first slow transformation product of thorium. Between thorium and radio-thorium there should be a similar genetic relation as exists between uranium and radium, which latter has been experimentally established by Soddy. [For a fuller account of all the author's work on the subject see Jahrbuch d. Radioakt. u. Elektrotonik, 2. 3. pp. 233–266, Oct., 1905.] L. H. W.

2190. *Induced Radio-activity (Elster-Geitel Effect).* **E. Sarasin, T. Tommasina,** and **F. J. Micheli.** (Phys. Zeitschr. 6. pp. 709–715, Oct. 26, 1905. Paper read before the Liége Congrés de Radiologie. From the French.)—The authors have previously given an account of experiments in which the presence of a temporary radio-activity is produced in wires maintained at high potential in atmospheric air and also in air ionised by Röntgen rays [see Abstract No. 732 (1905)]. In the present paper these experiments are re-performed and extended to the case in which the wires are coated with some dielectric substance. In the case of a zinc-coated iron wire which has been maintained for 21 hours at a negative potential of 2,000 volts, the rate of decay of activity is plotted in the form of a curve; the conductivity produced in air by it is throughout slightly greater for a + than for a − charge. On coating the wire with a continuous layer of some dielectric it is found that the + curve lies beneath the − curve. The authors explain this on the assumption that the conductivity for − charge is produced by α-rays consisting of + ions, and that for the + charge by β-rays consisting of − electrons. The latter penetrate into the dielectric, and are given out during the decay of activity with less velocity than those for a bare wire. The γ-rays play a very small part in this phenomenon. A simple experiment is then described, in which a piece of damp string is used instead of a wire. When thoroughly wetted and allowed to dry, the slightly damp core causes it to behave like a wire coated with dielectric, *i.e.*, the + curve lies below the negative; when wetted on the outside only, it behaves like a bare wire. For a wire situated in the open air outside the laboratory the activity and rate of decay are less than for a similar wire inside the laboratory. Further experiments show that the radio-activity induced in a wire connected with the − pole of a battery is enormously greater than when connected to the + pole. It is concluded that this induced radio-activity may play a part in the discharge from a negatively charged conductor. S. G. S.

2191. *Radio-activity of Austrian Thermal Springs.* **H. Mache** and **S. Meyer.** (Phys. Zeitschr. 6. pp. 692–700, Oct. 26, 1905. Paper read before the Liége Congrés de Radiologie.)—The results of the author's investigations of various radio-active springs in Austria are here given in a condensed form, enabling comparisons to be made, and are discussed at some length. [See Abstracts Nos. 366, 989, 1395, and 1894 (1905).] The sediment known as reissacherite (a form of pyrolusite) from Gastein is fully described as to its properties, as well as sediments from other sources. "Reissacherite" is found as a layer on minerals; it makes Sidot blende glow, and gives out both α- and β-rays (the latter forming about 10 per cent. of the total) of variable activity up to 3·9 times that of uranyl nitrate for the same surface, being thus even more active than metallic uranium. A piece of the deposit found in 1856 only showed an activity of 0·05 uranyl. But the layer was only very thin, while the uranyl was 8 mm. thick. If it be assumed that in the most active specimen the radium content is eighty times as great, then radium is here present in the greatest known concentration. From the author's values for a solution of radium chloride from pitchblende, taking the value for a calculated from the results of Curie and Laborde, and of Duane, it is worked out that 480 kg. of pitchblende would, if fully utilised, suffice to produce 1 gm. of pure radium bromide. L. H. W.

2192. *Method of Transmission of Radium Excited Activity to the Kathode.* **W. Makower.** (Phil. Mag. 10. pp. 526–532, Nov., 1905. Communicated by the Physical Society. Phys. Zeitschr. 6. pp. 915–918, Dec. 15, 1905.)—The amount of activity deposited on a rod is investigated under different conditions of pressure and distance apart of the electrodes. When the gas pressure reaches as low a value as 2 mm. the amount diminishes very rapidly; there is also deposition on the anode as well as the kathode. These effects are the more noticeable in the smaller vessels. Independent ionisation of the gas produces no alteration in the amount; it is therefore concluded that the excited activity possesses the property of expelling negatively charged particles, and so becoming positively charged.—**W. H. Jackson.** (Ibid. pp. 582–587. Communicated by the Physical Society.)—In order to give additional force to Makower's conclusions, Jackson shows that the differences between experimental results and theory are less than the errors of observation. R. S. W.

2193. *Deflection of α-Rays from Radium and Polonium.* **A. S. Mackenzie.** (Phil. Mag. 10. pp. 538–548, Nov., 1905.)—The object of the experiments is to determine the magnetic and electrostatic deflection of the rays in order to find v and e/m. The rays coming through a slit fall on ZnS on glass; to the other side of this glass is applied the film side of a photographic plate. An exposure of some hours is made, to get an image of the slit when the rays are deflected and when they are not. Since radium in radio-active equilibrium is used, the radiations are not homogeneous; the extreme values of mv/e are $2{\cdot}65 \times 10^5$ and $3{\cdot}92 \times 10^5$. Rutherford gives $3{\cdot}98 \times 10^5$ for the α-rays from radium C, which are the fastest emitted, and finds for the velocity when they cease to cause phosphorescence $2{\cdot}55 \times 10^5$. The velocity v lies between $1{\cdot}18 \times 10^9$ and $1{\cdot}74 \times 10^9$, which is considerably less than Rutherford's value, and also less than that given by Des Coudres. The ratio $e/m = 4{\cdot}6 \times 10^3$ is also smaller than that obtained by previous observers. If e is the usual ionic charge, $m = 2{\cdot}2$ times that of a hydrogen atom. The magnetic and electric dispersions are very different; it may be that both H and He are sent out from the radium with nearly the same energy and therefore different momenta. mv/e for polonium $= 3{\cdot}30 \times 10^5$; the electrostatic deflection has not yet been measured. R. S. W.

REFERENCES.

2194. *Dihedral Stereoscope with Large Field.* **L. Pigeon.** (Comptes Rendus, 141. pp. 247–249, July 24, 1905.)—The instrument is intended for the observation of proofs taken by wide-angle objectives. It opens like a book, leaving a median partition which carries a mirror to be used by the left eye; the left-hand picture is therefore inverted, and the right eye looks directly at the right-hand picture. An eyepiece may be employed, but the field is greater without it. G. E. A.

2195. *Focussing Screen for Use in Photographing Ultra-violet Spectra.* **W. N. Hartley.** (Nature, 72. p. 581, Oct. 12, 1905.)—A photographic plate is fixed and washed, and when the film is nearly dry but still soft, it is dusted over with a powder of barium platinocyanide crystals. Using such a screen in a dark slide along with a good lens, the details in the group of Cd lines between $\lambda 2100$ and $\lambda 2400$ are well defined. G. E. A.

2196. *Astrophotometry.* **K. Strehl.** (Zeitschr. Instrumentenk. 25. pp. 199–205, July, 1905.)—In dealing with the measurement of delicate astronomical details, the varying effects depending on brightness of light source, bright or dark markings, and different apertures of objectives are considered in connection with the theoretical limits of distinct separation. [See also Abstract No. 754 (1905).] C. P. B.

2197. *Calibration of a Wedge Photometer.* **J. D. Maddrill.** (Astrophys. Journ. 22. pp. 138–149, Sept., 1905.)—Investigation of the divisional errors of a wedge photometer used at the Lick Observatory in a determination of a series of standards for faint stellar magnitudes, in accordance with the co-operative plan suggested by E. C. Pickering. C. P. B.

2198. *Increase in Sensitiveness of Bichromate Mixtures by Addition of Different Dyes.* **H. Calmels** and **L. P. Clerc.** (Photographic Journ. 45. pp. 309–311, Aug., 1905. Abstract from Monit. de la Photographie, July, 1905.)—The effect is studied when given quantities of erythrosin and eosin are added to bichromated gelatine enamel and bichromated albumen. The effect of the erythrosin in reducing the exposure reaches a maximum at about 2 gm. per litre of the enamel solution, that of the eosin at between 4 and 8 gm. per litre. The compositions of the enamel and albumen solutions are given. G. E. A.

2199. *Platinum Printing-out Paper.* **W. de W. Abney.** (Photographic Journ. 45. p. 318, Oct., 1905.)—The platinum paper made by the Kodak Co. may be used for printing-out, its qualities for this purpose being possibly due to its freedom from solarisation. The printing-out requires about four times as long as the development process. G. E. A.

2200. *Undulatory Form of the Photographic Function.* **A. Guébhard.** (Comptes Rendus, 141. pp. 559–562, Oct. 2, 1905.)—A Lumière film, placed under a translucent cover containing 1 to 22 thicknesses of white paper placed stepwise, was exposed to skylight from July 30 to Sept. 12, a period during which only 9 days of rain were registered. The result shows that with increasing exposure there is a maximum of impression followed by a minimum, and this again by a region of increasing impression, an experimental proof being thus furnished of the undulatory form of the photographic function. [See also Abstract No. 1560 (1905).] G. E. A.

2201. *Importance of Irradiation in Spectro-photography.* **A. Guébhard.** (Comptes Rendus, 141. pp. 462–464, Sept. 4, 1905.)—The author draws the attention of spectroscopists and astronomers to the fact that, by means of cuticular irradiation, the direct image of a white line may present all the variations of aspect which are observed in the spectroscope, and that there are none of the peculiarities in published extraordinary spectra but may be explained by the increase in the brightness of the source and the consequent photographic irradiation. G. E. A.

2202. *Photometric Study of Images in Optical Systems.* **E. Haudié.** (Journ. de Physique, 4. pp. 693–699, Oct., 1905.)—It is shown that, for all the usual types of optical systems, simple or complex, the ordinary conclusions relating to brightness and illumination may be deduced at once from the properties of intrinsic brightness and of the illumination of the image. The notion of a luminous flux is employed, and retinal, projected, and photographic images are considered. G. E. A.

2203. *Determination of Optical Character of Birefracting Minerals.* **F. E. Wright.** (Amer. Journ. Sci. 20. pp. 285–296, Oct., 1905.)—Descriptions are given of the methods by which the optical properties of a crystal can be determined by means of observations on plates cut (1) perpendicular to the acute bisectrix, (2) perpendicular to an optic axis, (3) parallel to the plane of the optic axes. T. M. L.

2204. *Metallic Reflection.* **R. Sissingh.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 335–344, Oct. 12, 1905. Proc. 8. pp. 377–387, Oct. 25, 1905.)—A mathematical treatise on the theory of reflection of light by imperfectly transparent bodies on the lines of an investigation by H. A. Lorentz which involves no special hypothesis as to the nature of the vibrations of light. E. H. B.

2205. *Assumed Abnormal Propagation of Light at the Focus.* **K. Strehl.** (Phys. Zeitschr. 6. pp. 513–514, Aug. 15, 1905.)—The diffraction theory leads to the fact that a phase displacement takes place in a spherical wave as it passes through the focus; but the author does not agree with the view that, on this account, the light is abnormally propagated in the focus, and in support gives results worked out from formulæ taken from his theory of the telescope. G. E. A.

2206. *Absorption Spectrum of Manganese Salts.* **P. Lambert.** (Comptes Rendus, 141. pp. 357–358, Aug. 7, 1905.)—The manganese was purified from iron by repeated precipitation as the dioxide, and was finally converted into the chloride. The absorption bands given by this salt were observed, and the measurements are given in the paper. E. C. C. B.

2207. *The Magnesium Spark.* **W. W. Strong.** (Astrophys. Journ. 22. pp. 119–122, Sept., 1905.)—The author has studied the spectrum of the spark between magnesium poles with a view of explaining Mohler's results on the reversal of certain lines when the spark is viewed in certain directions [see Abstract No. 1353 (1902)]. Detailed results are given in the paper, and are accounted for by supposing the existence of a reversing layer outside the spark. E. C. C. B.

2208. *Studies of Luminescence.* V. *Luminescence of Sidot Blende.* **E. L. Nichols** and **E. Merritt.** (Phys. Rev. 21. pp. 247–259, Oct., 1905.)—A photometric study of the luminescence of Sidot blende excited by various causes. Curves are given showing the brilliancy of the luminescence caused by the action of Röntgen rays and by the arc and spark discharges. Measurements were also made of the rate of decay of the phosphorescence after the exciting cause was removed. E. C. C. B.

2209. *Presence of Radium and Radio-active Rare-earths in the Fango Mud and Earth at Capri.* **F. Giesel.** (Ber. Deut. Chem. Gesell. 38. pp. 132–133, Jan. 21, 1905. Phys. Zeitschr. 6. pp. 205–206, April 1, 1905.)—From an examination of the decay curve and of the effect on a phosphorescent screen the author concludes that both substances are about 1/1000th as active as pitchblende. They contain both radium and emanium, the field earth also containing didymium; but no uranium is present in either. L. H. W.

2210. *Minerals Containing Thorium.* (Imperial Inst., Bull. 3. 2. pp. 151–166, 1905.)—A list is given of the best-known minerals which may be regarded as sources of thorium, with their percentage content of thoria. Their radio-active and other physical properties are then described, and reference is made to the commercial uses of thorium.

2211. "*Thorium Activity*" *of Monazite.* **F. Giesel.** (Ber. Deut. Chem. Gesell. 38. pp. 2334–2336, July 8, 1905. Chem. News, 92. pp. 91–92, Aug. 25, 1905.)—The thorium activity of monazite cannot be ascribed to thorium itself, since high values can be obtained in preparations almost free from thorium, the activity of some of the author's preparations being ten times as great as that of thorium hydroxide. T. M. L.

2212. *Radio-activity of the Sediments of Echaillon and Salins Moutiers.* **G. A. Blanc.** (Accad. Lincei, Atti, 14. pp. 322–328, Sept. 17, 1905. Phys. Zeitschr. 6. pp. 703–707, Oct. 26, 1905. Paper read before the Liége Congrés de Radiologie. From the French.)—The radio-active substance is chemically abstracted from the mud, and is used in the form of the hydrate. The rate of decay of radio-activity of the emanation is obtained, and is found to coincide closely with that obtained for thorium by Rutherford. The comparison for the induced radio-activity is equally good. [See also Abstract No. 737 (1905).] S. G. S.

2213. *Radio-activity of the Solid Lava of Vesuvius and the Soufrière of Pozzuoli.* **R. P. J. Costanzo.** (Annal. Soc. Sci. de Bruxelles, 29. pp. 218–220, 1904–1905.)—These bodies were examined for radio-activity by the photographic and also by the ionisation method, but the results were in all cases negative. No trace of radio-activity was found. S. G. S.

2214. *Spontaneous Scintillations of a Blende Screen.* **M. Seddig.** (Zeitschr. Wiss. Phot. 2. pp. 292–294, 1904.)—Baumhauer's observations are confirmed [see Abstract No. 1655 (1904)]. Since even with a hermetically sealed screen which has been kept away from the action of light for a long period, or is freshly made, scintillations are visible, the presence of these latter cannot be taken as a definite proof of radio-activity; they can be produced by various other causes. L. H. W.

2215. *New Rays or a New Emanation.* **J. J. Taudin Chabot.** (Phys. Zeitschr. 6. pp. 619–620, Oct. 1, 1905.)—Continuing his investigation of the properties of preparations of selenium [see Abstracts Nos. 1428 and 2906 (1904)], the author tries to observe the effect of one preparation of selenium on another similar one, the two being placed very close together; in no case is such an effect observable with certainty. S. G. S.

2216. *Radio-activity of Minerals, Rocks, and Springs.* **G. v. d. Borne.** (Jahrbuch d. Radioakt. u. Elektrotonik, 2. 1. pp. 77–108, May, 1905.)—A list of 39 minerals is given, the source and properties of each being indicated. The various rocks, lavas, muds, and waters examined by different experimenters are also tabulated. L. H. W.

2217. *Emanation Content of the Water of the Simplon Tunnel.* **G. v. d. Borne.** (Jahrbuch d. Radioakt. u. Elektrotonik, 2. 2. pp. 142–146, July, 1905.)—A map shows the position of the different strata, and tabulated data concerning these and the emanation content are given. Two groups are distinguished, called groups Th and R, by the author; in the first the activity falls off very rapidly initially, in the second it increases. The richest sources are the gneiss and granitic rocks. L. H. W.

2218. *Radio-activity of Lava.* **T. Tommasina.** (Phys. Zeitschr. 6. pp. 707–708, Oct. 26, 1905. Paper read before the Liége Congrés de Radiologie. From the French.)—The radio-activity of several specimens of lava of the latest eruption of Vesuvius (1904), collected while still hot, is measured by the conductivity apparatus of Elster and Geitel. Marked radio-activity is observed, but the numbers given are only comparative. S. G. S.

2219. *Action of Wood on Photographic Plates.* **W. J. Russell.** (Roy. Soc., Phil. Trans. 197B. pp. 281–289, Oct. 15, 1904. Proc. 74. pp. 131–134, Sept. 28, 1904. Abstract.)—The property of acting upon a photographic plate in the dark is shown to belong probably to all woods, but in a varying degree. The picture does not necessarily resemble the visible markings. Exposure to bright light intensifies the action in all woods; thin glass or mica interposed stops the action. It is the blue rays in the light which cause the increased action. L. H. W.

2220. *Absorption of Radium and Polonium Rays.* **E. Riecke.** [Experimental work by Retschinsky and Wigger.] (Phys. Zeitschr. 6. pp. 683–685, Oct. 26, 1905. Paper read before the Liége Congrés de Radiologie. Écl. Électr. 45. pp. 347–350, Dec. 2, 1905.)—The absorption of the α- and γ-rays of radium and the α-rays from polonium is studied in order to test a formula developed by the author. The conclusions are drawn that the α-rays are not homogeneous, and that the γ-rays are a species of Röntgen ray. R. S. W.

HEAT.

2221. *Cooling of Silver Wire Immersed in Water and Carrying Current.* **E. Rogovsky.** (Comptes Rendus, 141. pp. 622–624, Oct. 16, 1905.)—In a previous paper [see Abstract No. 1439 (1904)] the author has mentioned that the resistance of a silver wire immersed in water and carrying current first diminishes and then increases as the current is increased. The author gives readings which indicate this, and explains it on the assumption that for velocities of water above the critical velocity of Osborne Reynolds, a thin film still adheres to and slides along the wire. If the thickness of the film decreases as the current increases, the conduction of heat through this layer increases, and the wire at first falls in temperature and therefore in electrical resistance. Hence in order to obtain the electrical resistance of the wire at the temperature of the liquid, it is necessary to extrapolate from a series of readings made with different currents. S. G. S.

2222. *Specific Heat of Solutions of Copper Sulphate.* **P. Vaillant.** (Comptes Rendus, 141. pp. 658–660, Oct. 23, 1905.)—Joule's method of measuring specific heats was made applicable to liquids by putting the filament of an incandescent lamp in place of the metallic spiral which is traversed by the current and serves for heating the calorimeter. Assuming the copper sulphate to be present in the hydrated form, the specific heat of $CuSO_4 . 5H_2O$ varies from 0·1406 for a concentration of 0·7856 equivalents per litre to a maximum of 0·3 for 2·351 equivalents, and then falls to 0·2796 for a concentration of 2·7218 equivalents. D. H. J.

2223. *Heat given out by Radium.* **K. Ångström.** (Ark. för Mat., Astron. och Fysik, Stockholm, 2. No. 12, 1905. Phys. Zeitschr. 6. pp. 685–688, Oct. 26, 1905. Paper read before the Liége Congrés de Radiologie. From the French.)—Two metal vessels contain, the one a quantity of radium bromide, the other a heating coil. A current is sent through the latter until the steady temperature in each vessel is the same, this equality being shown by a thermocouple. No matter what the vessels are composed of—lead, copper, or aluminium—the amount of heat developed by the radium is the same, viz., 1·136 gm.-cals. per min. for every gm. of the radium bromide. The heating effect of the γ-rays is therefore small. [See also Abstract No. 760 (1905).] R. S. W.

2224. *Further Attempts to Liquefy Helium.* **K. Olszewski.** (Acad. Sci. Cracovie, Bull. 7. pp. 407–411, July, 1905. Ann. d. Physik, 17. 5. pp. 994–998, Sept. 26, 1905.)—Specially purified helium, cooled to —259° C. by solidifying hydrogen, was adiabatically expanded from 180 atmos. to 1 atmo., both slowly and suddenly, but no trace of liquefaction exhibited itself, though the temperature must have fallen to —271°·3. R. E. B.

2225. *Critical Point of Hydrogen.* **K. Olszewski.** (Acad. Sci. Cracovie, Bull. 7. pp. 399–406, July, 1905. Ann. d. Physik, 17. 5. pp. 986–993, Sept. 26, 1905.)—The author's experimentally determined value for the critical point of hydrogen, viz., —234°·5 C. [see Phys. Soc. Abstracts, No. 714 (1895)], depends on *extra*polation of the temperature-resistance curve of a platinum coil; extending this curve by taking —252°·5 for the boiling-point of hydrogen, the 1895 experiments give by *inter*polation —240°·8 for the critical point. This altered value would change Witkowski's estimation of —46° for the temperature of inversion of the Joule-Thomson effect for hydrogen to —87°, which agrees fairly well with the author's value —80°·5 obtained by experiment [see Abstract No. 858 (1902)]. A new determination of the critical pressure gives it between 15 and 13·4 atmospheres, which are the average pressures at which a capillary meniscus of hydrogen disappeared and reappeared. R. E. B.

2226. *Joule-Thomson Effect in Carbon Dioxide. I. Experimental.* **F. E. Kester.** (Phys. Rev. 21. pp. 260–288, Oct., 1905.)—A repetition of the porous plug experiments is here described. The gas used was that commercially supplied; in its passage it was thoroughly dried, and its pressure was regulated by a special control-valve: the plug was made of clean cotton fibre compressed between two thin perforated discs of steel, and the insulating material employed was red vulcanised fibre: the pressure difference was kept at about 1 atmo., and the actual mean pressures used varied from 7·6 to 41 atmos.: the temperature-differences of the gas and of the baths were measured by steel-constantan thermoelectric junctions, the former varying from 0°·75 to 1°·37 C., and the mean temperatures of the baths from 0°·6 to 96°·6. The percentage of impurity of the gas used in each experiment was measured, and varied from 0·17 to 2·2, but its character was unfortunately not examined: the cooling effect for a given temperature and pressure was determined with gas of different degrees of impurity, and was found in all cases to increase with diminution of impurity, and that for the pure gas was estimated by extrapolation. At 0° no dependence of thermal effect on pressure was found for pressures below 26°·4 atmos., at which one experiment showed an increased thermal effect: at 20° no variation was noticed up to 41 atmos., the highest pressure employed. The average cooling effects per atmosphere of pressure-difference deduced from the table given are 1·457 at —0°·55, 1·173 at 20°·4, 1·037 at 39°·5, 0·948 at 59°·5, 0·868 at 79°·5, 0·787 at 96°·5. R. E. B.

REFERENCES.

2227. *Relation of Melting-point to Expansion of Metals.* **J. v. Panayeff.** (Ann. d. Physik, 18. 1. pp. 210–212, Oct. 12, 1905.)—With data taken from Biedermann's Chem. Kalender for 1905, the author draws a curve which shows that the higher the melting-point of a metal, the smaller is its coefficient of expansion. The tin point lies farthest from the curve. G. E. A.

2228. *Ice Formation.* **S. T. Tamura.** (Monthly Weather Rev. 33. pp. 55–59, Feb., 1905.)—A *résumé* of the application by F. Neumann and Stefan of Fourier's theory of conduction to the problem of ice formation. R. E. B.

2229. *tφ-Diagram of a Saturated Vapour.* **L. Marchis.** (Journ. de Physique, 4. pp. 509–512, July, 1905.)—This curve, which is asymptotic to the φ-axis and tangent to the critical isothermal, has a point of inflection if the saturation specific heat of the vapour is always negative, but has, further, a serpentine bend if it has two points of inversion, being tangent to isentropics at the corresponding temperatures. R. E. B.

SOUND.

2230. *Telephonic Measurement of Acuteness of Audition.* **A. Stefanini.** (N. Cimento, 10. pp. 65–78, Aug., 1905. Accad. Lincei, Atti, 14. pp. 15–23, July 2, 1905.)—The apparatus consists of a pair of coils wound on a wooden ring—one, the primary, being in series with a battery, interrupter, and rheostat for altering the current in convenient ratios; the other, the secondary, being in series with the telephone. The secondary is so arranged that, by means of switches, any desired number of turns can be placed in series with the telephone. The current is adjusted until the normal ear can just hear the note of the interrupter when one turn of the secondary is employed. Then for any other ear the number of turns of secondary is increased until the note is just heard. This number gives the fraction of normal acuteness of audition possessed by the ear; in other words, its reciprocal is the acuteness of audition. If necessary, the primary current may be increased in a known ratio, as well as the number of secondary turns. The standardisation and use of the instrument are discussed. It has the advantage over other forms of such apparatus, in that the ratio of the loudness of two sounds produced by it can be determined accurately, the pitch being varied over wide limits. The irregularity of behaviour of the sliding cylinder apparatus is shown by making measurements of the displacement of the movable cylinder and the current in the secondary when no iron is used in the core. When iron is used, the results must be still more unreliable. S. G. S.

2231. *A Megaphone.* **G. Laudet** and **L. Gaumont.** (Comptes Rendus, 141. pp. 319–320, July 31, 1905.)—One of the authors patented in 1902 a megaphone similar to that which has since been described by Porter [see Abstract No. 1113 (1904)]. A style moves over the phonograph record to be intensified, and in doing so it closes and opens the orifices of two combustion chambers. The flames oscillate in unison with the sound recorded, and greatly intensify it. The style is so arranged that when it closes the orifice of one combustion chamber it simultaneously opens the other, so that the net flow of gas is sensibly the same. E. E. F.

2232. *Clearness of Telephone Sounds.* **E. Wiersch.** (Ann. d. Physik, 17. 5. pp. 999–1004, Sept. 26, 1905.)—In telephone and phonograph reproductions the hissing sounds, notably *s*, are imperfectly rendered or quite inaudible. This is not due simply to their feeble intensity as compared with vowels, for when provision is made for special loudness, the hissing sounds are all more or less like *f*, and cannot be distinguished. The author found, by means of flame analysis with acetylene instead of coal-gas, that the pitch of the sibilants is extremely high, the lowest constituent corresponding to the tone of a closed organ-pipe 14 mm. long, and the highest transcending the limits of audibility. Now all sounds impinging upon a diaphragm are deformed, and the deformation increases with the difference between the existing pitch and the fundamental tone of the diaphragm. These tones being low in most apparatus, the deformation of the sibilants is very great. When special contrivances are used in the way of magnets and tension devices to make the proper vibration of the high order specified, the consonants and sibilants are rendered with great accuracy. The fact that microphone reproductions tend to be too shrill is due, not to resonance, but to the fact that the periodic alterations of the resistance in the circuit practically double the pitch of all notes reproduced. E. E. F.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

2233. *Electron Theory.* **A. Sommerfeld.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 3. pp. 201–235, 1905.)—This is the third of a series of highly analytical papers, and deals with electrons at the speed of light and at greater speeds. It is too complicated for detailed abstraction, but it may be noted that the following are the chief topics discussed: (1) Sudden generation of speeds below and above that of light. (2) General graphical treatment of motion at speeds exceeding that of light. (3) The significance of the negative mass for quasi-acceleration. (4) The deflection of electrons at the speed of light. [See also Abstracts Nos. 2254, 2707 (1904), and 574 (1905).] E. H. B.

2234. *Origin of Electrification Produced by Bubbling Air through Liquids.* **K. Wolf.** (Beibl. Ann. d. Physik, 29. 13. pp. 692–693, 1905. Extract of Dissertation, Kiel, 1903.)—To explain the formation of "bubbling electricity," the Lenard double layer (air positive, water negative) is assumed, the electricities of which become free partly at the separation of the bubbles from the air-inlet tube, partly by the bursting of the bubbles at the surface of the water. Mere extension of the surface alone or the blowing of a blast of air over the surface of the water gives no appreciable electrification. The manner and the velocity of the formation of the bubbles, also the influence of different lengths of paths before the bursting of the air-bubbles, have been carefully studied by the author. After long use the water shows fatigue, from which it recovers on standing. Flame gases and smoke exercise a considerable preserving action on the electricities. Especially interesting but not explained are the varying but well-marked results which are obtained by bubbling air of varying pressure and velocity through common salt solution. D. H. J.

2235. *Transverse Momentum of an Electron.* **O. Heaviside.** (Nature, 72. p. 429, Aug. 31, 1905.)—When Newton's third law is applied to an electron, it makes $\mathbf{F} = \dot{\mathbf{M}} + \dot{\mathbf{N}}$...(1), where $\mathbf{M}$ is the "momentum" in the field, or that part of the time integral of the force on the ether which is in the field, or $\Sigma \mathrm{V} \cdot \mathbf{DB}$, and $\mathbf{N}$ is the momentum already wasted, whilst $\mathbf{F}$ is the applied force on the electron. Similarly, Newton's fourth law (or the Scholium to the third) makes $\mathbf{F}\mathbf{u} = \dot{\mathrm{U}} + \dot{\mathrm{T}} = \mathrm{W}$...(2), if $\mathbf{u}$ is the velocity of the electron, U the electric and T the magnetic field energy, and W the rate of waste of energy. Both W and $\dot{\mathbf{N}}$ are known in terms of the velocity and acceleration of the charge at any moment by formulæ previously given by the author [see Abstract No. 1080 (1903)]. But when applied to (1), (2), these equations do not let us determine $\mathbf{M}$ generally in terms of the velocity and acceleration, on account of the variability of the state of the field, and the waste of energy and momentum, $\mathbf{M}$, is indefinite. But in long-continued forced circular motion of a charge, $\dot{\mathrm{U}} + \dot{\mathrm{T}} = 0$.

So $\mathbf{F}\mathbf{u} = \mathrm{W} = \mu \mathrm{Q}^2 a^2 / 6\pi v \kappa$...(3), where Q is the charge and a the acceleration (or u^2/R, if R is radius of orbit). Also, $\kappa^2 = 1 - u^2/v^2$. The direct or $\mathbf{u}$ component of $\mathbf{F}$ is therefore known. Also (*loc. cit.*), $\dot{\mathbf{N}} = (\mathbf{u}/v^2)\mathrm{W}$...(4). Using this in (1), along with (3), the author finds $\kappa^2\mathbf{F}_1 = \dot{\mathbf{M}}_1$, $\mathbf{F}_2 = \dot{\mathbf{M}}_2$...(5), where $\mathbf{F}_1$ is the $\mathbf{u}$ component, and $\mathbf{F}_2$ the transverse component, towards the centre. Thus only the part $\kappa^2\mathbf{F}_1$ of the direct force is associated with the transverse or centripetal force $\mathbf{F}_2$ in keeping up the revolving state, the rest of $\mathbf{F}_1$, that is, $(u^2/v^2)\mathbf{F}_1$, being the wasted part as regards momentum, although the whole of $\mathbf{F}_1$ is concerned in the waste of energy. Now, $\dot{\mathbf{M}} = \mathrm{V}\mathbf{n}\mathbf{M}$, if $\mathbf{n}$ is the angular velocity. That is—

$$\dot{\mathbf{M}} = \dot{\mathrm{M}}_1\mathbf{u}_1 + \mathrm{M}_1\dot{\mathbf{u}}_1 + \dot{\mathrm{M}}_2\mathbf{a}_1 + \mathrm{M}_2\dot{\mathbf{a}}_2 \text{ .... } (6)$$

if $\mathbf{u}_1$ and $\mathbf{a}_1$ are unit vectors, making—

$$\dot{\mathbf{u}}_1 = (u/\mathrm{R})\mathbf{a}_1,\ \dot{\mathbf{a}}_1 = (u/\mathrm{R})\mathbf{u}_1. \text{ .... } (7)$$

Also $\dot{\mathrm{M}}_1 = 0$, $\dot{\mathrm{M}}_2 = 0$, because the motion is steady. So we convert (5) to—

$$\left.\begin{aligned} \kappa^2\mathbf{F}_1 &= \dot{\mathbf{M}}_1 = -\mathrm{M}_2(u/\mathrm{R})\mathbf{u}_1, \\ \mathbf{F}_2 &= \dot{\mathbf{M}}_2 = \mathrm{M}_1(u/\mathrm{R})\mathbf{a}_1. \end{aligned}\right\} \text{ .... } (8)$$

Finally, although the author gets no formula for M_1, he finds for M_2 the complete formula—

$$\mathrm{M}_2 = -\mu \mathrm{Q}^2 a/6\pi v\kappa^2 \text{ .... } (9)$$

This is the transverse momentum of Q in steady circular motion, without any limitations upon the size of the velocity and acceleration, save the usual ones, $u < v$, and a not excessively great in regard to the diameter of the electron. The author acknowledges that he was led to see that his waste formula could result in (9), through some calculations submitted to him by G. F. C. Searle.

E. H. B.

2236. *Duration of Lightning-flashes.* **K. E. F. Schmidt.** (Elektrotechn. Zeitschr. 26. pp. 903–904, Sept. 28, 1905.)—The apparatus used by the author consisted of a disc 10 cm. diam. driven by clockwork, and having a white cross painted on a black background, the thickness of the arms of the cross being 2 mm. The speed of rotation was between 50 and 60 revs. per sec., and the nature and duration of the lightning-flash were estimated from the appearance presented by the rotating disc when illuminated by the flash. This appearance varied greatly in different cases; sometimes there appeared a single sharp image of the white cross, while at other times 2, 3, or more (in one exceptional case of an extremely vivid flash, 8) images were observed; the edges of the arms were in some cases sharply defined, in others blurred. From the observations the author concludes that the duration of a lightning discharge varies widely, and that if the discharge is oscillatory the period must be less than 1/30000 sec.

A. H.

2237. *Electrical Charge of the Earth and Lower Layers of the Atmosphere.* **H. Gerdien.** (Phys. Zeitschr. 6. pp. 647–666, Oct. 15, 1905.)—The author shows first, that the excess of positively charged ions in the lower layers of the atmosphere as calculated from the potential gradient is not nearly so great as that indicated by the direct measurements of Elster and Geitel [see Abstract No. 2259 (1904)] and Ebert [Abstract No. 820 (1905)], and he thinks that the discrepancy is due to the distortion of the electric field caused by the apparatus, and to the fact that the apparatus only measures the more rapidly-moving ions; since the ions are more likely to be weighted with moisture, this would cause an apparent excess of + ions. The theories of Elster and Geitel [Abstract No. 2018 (1900)] and of Ebert [Abstract No. 1172 (1904)] and the criticism of Simpson [Abstract No. 2988 (1904)] are given, and the evidence in these papers is discussed at length. The author then goes on to describe his condensation hypothesis. On rapid and therefore adiabatic expansion of the air condensation of moisture takes place, and the supersaturation which is necessary to cause condensation on the + ions is much greater than that for the — ions; hence the latter, being weighted in this way, will sink relatively to the air in which they exist, thus causing a separation of the — and + charges. The author traces the changes occurring as a column of moist air rises. At a certain point, condensation on dust particles and suspended matter begins, giving rise to the cumulus cloud. At greater altitudes the dust has all been removed and no cloud is formed. On still ascending, a point is reached at which the supersaturation is sufficient to cause condensation on the — ions to begin; this is the "falscher Cirrusschirm." Electric separation now goes on so long as the relative downward velocity of the condensation product is greater than that of the + ions due to the field produced. The disruptive discharge may now take place, giving rise to further ionisation by impact, thus replenishing the store of ions. The — charge may be carried to earth by the descending drops, or discharge may take place between the — layer and earth. After removal of this layer the remaining + layer spreads outwards owing to the mutual repulsion of its constituent parts. The meteorological phenomena accompanying these electric effects are described in considerable detail. S. G. S.

2238. *Electric Observations of the Atmosphere during the Solar Eclipse.* **A Gockel.** (Phys. Zeitschr. 6. pp. 617–618, Oct. 1, 1905.)—During the solar eclipse of Aug. 30, 1905, the potential gradient, conductivity, and ionic concentration were measured at Vinaroz on the Mediterranean coast of Spain. The atmospheric conditions were unfavourable, but a slow decrease in the potential gradient, before the eclipse, and a rapid rise at the eclipse, followed by a slow decrease, were observed. The conductivity followed a similar course, and the ionic concentration underwent small and irregular changes. S. G. S.

2239. *Ionisation of the Atmosphere during the Total Eclipse of the Sun.* **H. Ebert.** (Phys. Zeitschr. 6. pp. 641–647, Oct. 15, 1905.)—The author used his aspiration apparatus [see Abstract No. 820 (1905)] for the determination of the number of + and — ions of velocity greater than 0·2 cm./sec. per volt/cm. in the atmosphere at the time of the solar eclipse of Aug. 30, 1905. The observations were made at Palma de Mallorca, and for the sake of comparison observations were made with the same apparatus before starting and on the outward and return sea voyages. Although the number of observations is not great, it appears that the ionic concentration is less at sea and on the coast than inland, the difference being greater for the + than for the — ions, the ratio of the number of + to that of — ions being nearer unity on the sea than inland. The weather during the eclipse was so unfavourable that the observations do not lead to any definite conclusion, but a decrease in concentration of — ions was observed during and immediately after totality. The author is not satisfied that this may not be a secondary effect due to the cooling of the atmosphere as the moon's shadow passes through it; the cooling would cause condensation of the moisture present, and this would take place chiefly on the — ions, whose velocity would be so much reduced that many would escape through the aspiration tube. S. G. S.

DISCHARGE AND OSCILLATIONS.

2240. *Opacity of Aluminium-foil to Ions from a Flame.* **G. A. Carse.** (Roy. Soc. Edinburgh, Proc. 25. pp. 903–907, 1904–1905.)—One end of a chamber containing a sensitive electroscope is closed by thin aluminium-foil. Past this are drawn the combustion products from a Bunsen burner. The ions are unable to penetrate this: the conditions are such that if 1 per cent. pass through they could be detected. [See also Abstract No. 1220 (1905).] R. S. W.

2241. *Ratio ε/μ for Kathode Rays Differently Produced.* **R. Reiger.** (Ann. d. Physik, 17. 5. pp. 947–959, Sept. 26, 1905. Écl. Électr. 45. pp. 147–149, Oct. 28, 1905.)—This ratio for kathode rays emitted by a negatively electrified glass plate under the action of ultra-violet light, measured by Lenard's method, was found to lie between $9{\cdot}6 \times 10^6$ and $1{\cdot}2 \times 10^7$; for kathode rays of striction produced in a narrow tube this ratio, estimated by an electrostatic deviation method, was $1{\cdot}32 \times 10^7$; for kathode rays produced at a long-used anode and due to anomalous drop of potential the ratio found was $1{\cdot}68 \times 10^7$. R. E. B.

2242. *Kathode-fall and Potential Gradient of the Halogens.* **G. Bode.** (Phys. Zeitschr. 6. pp. 618–619, Oct. 1, 1905. Écl. Électr. 45. pp. 260–261, Nov. 18, 1905. Abstract.)—With a Pt electrode the kathode-fall in oxygen, determined at a temperature between 200° and 300° to ensure absence of ozone, is found to be 370 volts as a mean, this agreeing well with Capstick's result [see Abstract No. 83 (1899)]; with an Al electrode, 300–320 volts. The potential gradient is of about the same value in nitrogen as in oxygen, the ratio *gradient/pressure* in the latter varying from 60 down to 28·6 for pressures of 0·1 to 0·7 mm. In the case of chlorine the kathode-fall is low, 320–340 volts, although the sparking potential in Cl is so high; the potential gradient is, however, nearly three times that in oxygen (ratio, *gradient/pressure* varies from 103·3 to 65·8 for pressures 0·2 to 1·9 mm.). The kathode-fall for bromine is between 376 and 414 volts and the above given ratio has the values 185·5 to 69·4 for pressures 0·14 to 0·75 mm. For iodine the values for the kathode-fall obtained lie between 380 and 430 volts. The special arrangement adopted in the case of the examination of the two latter gases is described. L. H. W.

2243. *Radiation from Insulators at Atmospheric Pressure.* **R. Reiger.** (Ann. d. Physik, 17. 5. pp. 935–946, Sept. 26, 1905. Extract from Erlanger Habilitationsschrift. Écl. Électr. 45. pp. 264–265, Nov. 18, 1905.)—The loss of a negative charge under the influence of ultra-violet light has been generally considered a property of metals and a few non-metallic conductors. In this paper the author shows that almost all bodies exhibit a sensibility to electric light. In the experiments described, the insulator under investigation was in the form of a square plate of 6 cm. side. On the back of this was fastened a circular disc of tin-foil connected by means of a copper wire to the negative pole of a battery, whose other terminal was earthed. The tin-foil disc (2 cm. radius) formed one half of a small condenser, the other plate being connected to one pair of quadrants of an electrometer, and the other pair being earthed. The sensitiveness of the electrometer was about $2{\cdot}5 \times 10^{-3}$ volts per scale division. The electrometer and condenser were enclosed in a tin box, through a hole in which the light from an arc lamp was allowed to fall obliquely on the face of the insulator under investigation. The effective rays for most substances were found to be in the ultra-violet. The insulator was shown to be at the same potential as the tin-foil disc, and the radiation stream from its surface was observed by means of the electrometer, which always had a small leak. This was practically the same whether the insulator was charged negatively or positively, if no light fell on its surface, but the loss when the plate was negatively charged was about 50 times as great as when positively charged when under the influence of ultra-violet light, showing that the negative charge alone produces any appreciable radiation. The radiation from different specimens of glass varied in amount, but was always of the same order of magnitude. The results for other substances are given in the following table. The insulators were charged to a potential of —2,400 volts, and the current in the arc lamp was 5 amps.

Insulator.	Thickness, in mm.	Radiation Current, Amp. $\times 10^{-13}$
Ebonite	1·05	17·8
„	2·94	70·0
„	5·07	33·5
Mica	0·6	18·8
Sealing Wax	2·85	35·2
Wax	4·7	2·3
Resin	4·75	16·4

The results may be summarised thus: Electric radiation issues from insulators in the same way as from metals. The results for different substances are only distinguished by the intensity of the radiation stream. This intensity was found to be smaller for insulators than for carbon and also for aluminium. The difference in intensity does not arise from the resistance of the insulator, since the potential drop through the insulator can be neglected if the thickness is small. Lenard's researches [see Abstract No. 1845 (1900)] show that the radiations from metals correspond to kathode rays, which issue from the metal and are absorbed in the immediate neighbourhood. This is also true for insulators, since in a vacuum under the influence of ultra-violet light, kathode rays likewise issue from a negatively charged plate of the insulator.

A. W.

2244. *Recombination and Size of Gaseous Ions.* **J. J. Thomson.** (Cambridge Phil. Soc., Proc. 13. pp. 170–173, Oct. 25, 1905.)—From the theory of central forces it is known that, if two ions are a distance apart r, and the kinetic energy, T, due to their relative motion is greater than e^2/r (e being the charge on an ion), they will not describe closed orbits round each other, but will ultimately get an infinite distance apart, *i.e.*, they will not recombine. Thus for recombination to occur they must approach within a distance r such that $T < e^2/r$ or $r < e^2/T$. If N is the number of molecules in 1 c.cm. of gas, we have $p = \frac{1}{3}NT$, whence $e^2/T = Ne^2/3p = r = 1{\cdot}4 \times 10^{-6}$ cm. If V is the relative velocity of the ions, and n the number of each kind per c.cm., an ion in time t will come within combining distance of $n\pi r^2Vt$ oppositely-charged ions. Thus the number of recombinations per ion per sec. is $n\pi r^2V$, and the number per unit volume $= n^2\pi r^2 V$. But if α is the coefficient of recombination, this number is $= \alpha n^2$, hence $\alpha = \pi r^2V$. If the ions in H have the same mass as the molecule, $\alpha = 1{\cdot}5 \times 10^{-6}$, agreeing in order with the experimental value which is about 10^{-6}. The surrounding gas will resist motion, and so cause more ions to fall together, hence we should expect α, determined by this equation, to be too small, while actually it is too large. It is therefore inferred that V for the H ion is less than for the molecule, or the mass of the former greater than, but not a large multiple of, that of the molecule. A strong electric field will make the kinetic energy much greater than has been assumed in the above, and so will diminish α. By similar reasoning the number of combinations of ions with unchanged molecules is found to be $\pi Nn\,(2{\cdot}7 \times 10^{-8})^2V$, where N is the number of molecules and n the number of ions per c.cm.; owing to N being at least 10^{12} times n, this is 5×10^8 the number of combinations between oppositely charged ions. Hence the ions from the commencement of their career are attached to molecules. It is also found that the ions in different gases will not differ so much in size as the molecules of the gases. R. S. W.

2245. *Emission of Negative Corpuscles by Alkali Metals.* **J. J. Thomson.** (Phil. Mag. 10. pp. 584–590, Nov., 1905.)—It is well known that the alkali metals when exposed to light give out negative corpuscles, even when the light is very feeble. The author now finds that with rubidium and the liquid alloy of sodium and potassium there is a small emission of corpuscles, even when all external light is excluded. In the tests here described a gold-leaf electroscope with quartz insulation was used enclosed in a glass vessel containing the metal, and which was exhausted to a very low vacuum by charcoal cooled by liquid air in the way discovered by Dewar. When the leaves of the electroscope were charged with *positive* electricity there was always, even in the dark, a small leak of electricity from the leaves, while there was no perceptible leak when the leaves were *negatively* charged. The positive leak was entirely stopped by a transverse magnetic field: this proved that it is due to negative corpuscles emitted by the rubidium or the alloy of Na and K.
E. H. B.

2246. *Determination of the Coefficient of Coupling of Oscillation Transformers.* **J. A. Fleming.** (Phys. Soc., Proc. 19. pp. 603–614; Discussion, pp. 614–615, Oct., 1905. Phil. Mag. 9. pp. 758–767, June, 1905.)—A more compact form of the author's cymometer, enabling a larger range of the oscillation constant to be measured, is described, and its use for the determination of capacities, inductances, and coefficients of coupling of oscillation transformers more fully dealt with than in the former paper [see Abstract No. 824 (1905)]. To determine the capacity of a small Leyden jar for instance, the jar (of capacity C_1 in mfd.) has its inner and outer coatings connected to one pair of ends of a rectangular circuit of insulated wire (supplied with the instrument and of known (calculated) inductance L_1, in cm.), and the other pair is connected to the spark-balls of an induction coil. The cymometer bar is placed parallel to one side of the rectangle and oscillations set up. The oscillation constant, O_1, read off when the neon tube glows most brightly is then the same for both the jar and the cymometer circuits ; then $C_1 = O_1^2/L_1$. The expression $M/\sqrt{LN}$ is called the coefficient of coupling, k, of an oscillation transformer, where L and N are the inductances of the primary and secondary circuits respectively, and M is the mutual inductance. The coupling is considered to be close or loose according as $k \gtrless 0{\cdot}5$. To determine k the two circuits of the transformer are joined into one circuit, first so as to assist and then so as to oppose each other's action ; the effective inductances L_1, L_2, in the two cases are $L + 2M + N$ and $L - 2M + N$. Hence $M = (L_1 - L_2)/4$ and $L + N = (L_1 + L_2)/2$. L or N is then determined directly and independently. The theory is then dealt with, and it is shown that the condition that oscillations of only one frequency shall be present when two circuits of the same oscillation constant are coupled is that k shall be very small ; otherwise two frequencies n_1, n_2, are present, as is well known, the one being lower and the other higher than the original single frequency n_0. The relation between these frequencies is $n_1^2(1 - k) = n_0^2$; $n_2^2(1 + k) = n_0^2$.

L. H. W.

2247. *Electric Oscillations in Annular Metal Tubes.* **A. Kalähne.** (Ann. d. Physik, 18. 1. pp. 92–127, Oct. 12, 1905. Phys. Inst. d. Univ., Heidelberg, July 17, 1905.)—The author shows that the solution by Weber of the problem of the production of stationary electric waves in a metal tube of infinite length [see Abstract No. 96 (1903)] can be extended to the case of a tube of rectangular section bent into the circular form ; then by indefinitely increasing the radius of the circle the tube becomes a straight one of rectangular section, or by indefinitely decreasing the inner diameter a cylindrical surface with a line along its axis is produced. The paper is entirely mathematical, and the method adopted by Weber in the above-mentioned paper is followed.

S. G. S.

2248. *Resistance of a Coherer Contact.* **A. Blanc.** (Journ. de Physique, 4. pp. 743–760, Nov., 1905. Paper read before the Soc. franç. de Physique, May 4, 1905.)—Following up his former research [see Abstracts Nos. 1818 (1901) and 1923 (1905)], the author has come to the following conclusions on contact phenomena : The particles of two surfaces in contact diffuse into one another at a slow rate, which process is assisted by rise of temperature, current, or pressure. Current acts like pressure, for in the former case an attraction $= KV^2/8\pi d^2$ exists across the high contact-resistance, where $V =$ fall in potential across the contact, $d =$ distance between the separated surfaces. This force corresponds in action to a direct mechanical pressure. [See also Abstract No. 1461 (1905).]

P. E. S.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2249. *Specific Resistance of Aluminium-Zinc Alloys.* **A. Sturm.** (Beibl. Ann. d. Physik, 29. 3. pp. 143–144, 1905. Extract of Rostock Dissertation, 1904.)—Cast sticks of the alloy 16 sq. mm. in section were used, Matthiessen and Hockin's method being employed. To obtain consistent values the sticks were several times heated nearly to the melting-point and very slowly cooled. For pure Zn the specific resistance is found to be 0·05371 at 0°, and the temperature coefficient 0·004092 ; for pure Al the corresponding figures are 0·02806 and 0·604378. The alteration of these values with time, to obviate which the above treatment was adopted, is attributed to the formation of chemical compounds on cooling, the equilibrium condition not being obtained with rapid cooling.

L. H. W.

2250. *Electrical Resistance of Bismuth and Antimony.* **E. Schnorr v. Carolsfeld.** (Beibl. Ann. d. Physik, 29, 19. pp. 998–999, 1905. Extract of Dissertation, Munich, 1904.)—The author examined wires of Bi, of Sb, and of alloys of both metals, prepared by Wachsmuth and Bamberger's method. [See Abstract No. 1466 (1900).] The following is a summary of the results: (1) Bismuth wires in glass, which cool off under pressure, show, when an alternating current is passed through, a very clearly marked secondary e.m.f. produced by the former, even when not in a magnetic field. The components of this secondary e.m.f. and of the compensating self-induction are of a different order in the above wires to those in wires made by pressing. (2) Impurities produce little effect. (3) The intensity and phase of the secondary e.m.f. can be expressed by simple formulæ, when not in a magnetic field, as a function of the current frequency. (4) The above peculiarities are observable, though in a much reduced degree, with wires of an alloy of 5 parts Bi to 3 of Sb, and also in pure Sb. The resistance of the wires to alternating currents is always slightly less than for continuous currents, and decreases with increase of frequency; but a compensating self-induction must be included in the bridge-arm to obtain silence. The self-induction required is smaller with increasing frequency. Some of the author's results are not in agreement with those of Lenard and Bamberger. L. H. W.

2251. *Electrical Conductivity of Selenium.* **M. Coste.** (Comptes Rendus, 141. pp. 715–717, Nov. 6, 1905.)—Most metals combine to some extent with selenium, and the author shows that this is the case also with gold. Two methods of preparing carbon for electrode purposes are given, and microscopic observations of the structure of selenium discussed. To obtain selenium in a very light-sensitive condition the metal should be in the least compact state possible. The author considers the effect of light to be due both to modification of the selenium surface and the thermal effects due to absorption of luminous radiations. L. H. W.

2252. *Dielectric Constants of Metals in the Case of Heat- and Light-waves.* **A. Broca.** (Comptes Rendus, 141. pp. 24–26, July 3, 1905.)—A further application of the idea that metals may have a high dielectric constant. [See Abstract No. 1627 (1905).] The author concludes that, though this hypothesis may not be able to explain all the optical properties of metals, it is yet not more at variance with those properties than is the theory of Planck, which puts the dielectric constant at zero. E. H. B.

2253. *Observations on Stressed Dielectrics.* **K. Germanischskaja.** (Beibl. Ann. d. Physik, 28, 20. p. 1070, 1904. Abstract of Inaugural Dissertation, Zürich, 1903.)—The first part deals theoretically with the possibility of there being a dielectric coercivity, the existence of which might be confirmed by observations with built-up condensers. The condenser actually employed consisted of two removable metal plates and a dielectric which was in three layers. The condenser was charged and then taken to pieces, and the central layer of the dielectric tested as to its electrical condition. It was found, as a result, that indiarubber does, and ebonite does not, show coercivity. No definite results were obtained with paraffin, glass, or guttapercha. Details of the experimental method or numerical results are not given in the Abstract. L. H. W.

2254. *Specific Inductive Power of Benzene and Water.* **F. Beaulard.** (Comptes Rendus, 141. pp. 656–658, Oct. 23, 1905.)—The relation given by L. Graetz has been used to determine the dielectric constants of benzene and water. The liquids were enclosed in thin glass ellipsoids; the Hertz electric field was employed; the effect of hysteresis was reduced to a minimum by making observations by the mirror method and deducing α from the first elongations. For a wave-length of about 50 m., K was found equal to 1·657 for benzene, and 11·04 for water; the latter value is much less than is usually assumed. D. H. J.

2255. *Thomson Effect in Mercury.* **C. Schoute.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 210–215, Oct. 12, 1905. Proc. 8. pp. 381–386, Oct. 25, 1905.)—This determination has been executed as a sequel to that undertaken by H. Haga. (Ann. de l'Ecole Polytechn. de Delft, 1, p. 145, 1885; III. p. 43, 1887.) The value of the Thomson effect was expressed by a relation obtained by integration of the differential equation which Verdet has given for the points of an unequally-heated homogeneous conductor when an electric current passes through it. Some details of the experiments carried out are given, and the general conclusion arrived at is that when a current of 1 amp. passes through a column of mercury, the Thomson effect causes a quantity of heat equal to σ (where $\sigma/T = -267 \times 10^{-11}$, T being the absolute temperature) to be developed in 1 sec. between two consecutive sections of the temperatures $t - \frac{1}{2}°$ and $t + \frac{1}{2}°$, if the current goes in the direction of the increasing temperatures. F. E. S.

2256. *Determination of E.M.F. and Internal Resistance of Cell.* **E. Steinmann.** (Centralblatt Accumulatoren, 6. pp. 212–213, Sept. 1, 1905. From "La Machine," July 25, 1905.)—A voltmeter whose resistance and therefore sensitiveness can be varied is used to take two direct measurements of the p.d. between the cell terminals. Knowing the ratio of the resistances of the instrument in the two cases the total e.m.f. (E) and internal resistance (ρ) of the cell can be found.

$$E = e''\left(1 + \frac{e' - e''}{e'' - \frac{e'\rho''}{\rho'}}\right), \qquad \rho = \rho''\left(\frac{e' - e''}{e'' - \frac{e'\rho''}{\rho'}}\right).$$

e' and e'' are the p.d.'s observed, and ρ' and ρ'' the respective resistances of the voltmeter. S. G. S.

2257. *The Falling-plate Oscillograph as a Phase Indicator.* **W. McClellan.** (Amer. Phil. Soc., Proc. 44. pp. 166–176, May–July, 1905.)—A full description is given of the Duddell double oscillograph and a method of using it to find the phase difference between the current in a load, and the p.d. at its terminals described. One oscillograph circuit is placed in the main circuit and the other shunts the load. The angle of lag of the current in the shunt circuit behind the applied p.d. is appreciable, and so is the lag of the current in the main circuit behind the applied p.d. From the oscillogram the phase difference between, and the amplitudes of, the two current waves can be found. The inductive load is now replaced by a non-inductive resistance, and new records are taken from which the angle of lag of the current in the shunt circuit can be found. Assuming that the current and p.d. vectors are in one plane, a formula is found for the phase difference between the original main current and the applied p.d. Owing to the unavoidable errors in the oscillograms the method is not suitable when the phase difference between the current and the applied p.d. in the shunt circuit is small.

A. R.

2258. *Battery Resistance by Mance's Method.* **A. W. Smith.** (Science, 22. pp. 434–439, Oct. 6, 1905.)—The object of this paper is to show wherein many writers have erred in the explanation of Mance's method, and to indicate a direct and simple derivation of the desired relationship. The first edition of Maxwell states that, while many of the methods commonly used to measure the resistance of a battery are rendered doubtful owing to alterations in the current strength, Mance's method is free from this objection. Lodge (Phil. Mag. p. 515, 1877) pointed out this error in Maxwell, but it is still printed in some modern text-books. It is shown that the battery current may change from a few thousandths of an ampere to several tenths, and that there is only a superficial analogy between Mance's method and that of Wheatstone's bridge. The author also gives results of a number of observations of battery resistance by Mance's method as modified by Lodge, a condenser being joined in series with the galvanometer. The results appear to be very satisfactory. F. E. S.

2259. *Electrical and Thermal Conductivity of some Copper-Zinc Alloys.* **G. Grossmann.** (Beibl. Ann. d. Physik, 29. 4. pp. 178–181, 1905. Extract of Dissertation, Zürich, 1903.)—Cast rings of different alloys were prepared from electrolytic copper and chemically pure zinc, the alloys containing about 10, 25, 75, and 90 per cent. by weight of Cu. The rings were turned down to about 1·7 cm. square section and examined as to their electrical conductivity, after which they were turned down smaller and their thermal conductivity determined. The electrical conductivity was determined by the damping produced in an oscillating magnetic needle placed near the ring. The mean specific heats for the temperature interval 0–27° were first ascertained by the method of mixtures. The thermal conductivity was arrived at by H. F. Weber's method of supplying heat to the ring, which is then allowed to cool off in a space maintained at a constant temperature (Naturforsch. Gesell., Zürich, 25. p. 161), double thermo-elements being employed for the temperature measurements. The results are given in the following table, where x is the electrical, and k the thermal conductivity (at 18·5° unless otherwise stated), and a is the temperature coefficient of resistance. Attention is called in the Extract to the values of the exponents in the columns for x and k/x, which seem to be incorrect.

	Cu Content, per cent.	$x \times 10^5$ (?)	a	k, gm.-cal.	Specific Heat, gm.-cal.	Ratio of Conductivities. $\frac{k}{x} \cdot 10^{-4}$, (?) gm.-cal.
Sn	0	8·45	0·00418	0·1424	0·0529	0·1685
90Sn, 10Cu	9·75	8·43	0·00403	0·1309	0·0555	0·155
75Sn, 25Cu	24·95	8·64	0·00229	0·1395	0·0605	0·1615
25Sn, 75Cu	75·55	3·22	0·00062	0·0590	0·0816	0·1835
10Sn, 90Cu	90·1	6·15	0·00224	0·1052	0·0862	0·171

The conductivity ratio thus at first decreases, to increase again later, whilst in copper-rich alloys the ratio increases with increase of Sn, the opposite to the electrical conductivity. Probably the maximum of the conductivity ratio is at the point where both conductivities show a minimum. L. H. W.

2260. *Quadrant Electrometer.* **O. M. Stewart.** (Phys. Rev. 21. pp. 229–246, Oct., 1905.)—This paper is a mathematical investigation of the properties of the quadrant electrometer as used for the measurement of small currents through some gas. It is generally assumed that $d\theta/dt$ is proportional to the current through the ionised gas, where θ is the angular deflection of the needle. This relationship assumes that (1) the capacity is constant, and (2) the deflection is proportional to the product of the potentials of the quadrants and the needle, when the needle is in motion and also for steady deflections. The capacity, however, varies as the needle moves, and in many cases this variation cannot be neglected. Also the relationship (2) is not true when the needle is in motion, for in this case a damping effect is introduced. F. E. S.

2261. *Analysis of Curves obtained with the String Galvanometer.* **W. Einthoven.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 824–886, May 11, 1905. Proc. 8. pp. 210–268, Oct. 25, 1905. Archives Néerlandaises, 10. pp. 414–482, 1905.)—The string galvanometer consists of a silvered quartz thread stretched in the field between the poles of an electromagnet. [See Abstracts Nos. 1451 (1903), 1190 (1904), and 172 (1905)]. It is a sensitive oscillograph by means of which periodic currents of small intensity may be photographically recorded. The paper is a somewhat lengthy and detailed mathematical discussion of the motion of the quartz fibre, and the influences which affect it, such as air-damping, magnetic damping, mass and elasticity of the thread &c., &c., and also of the accuracy with which it may be made to reproduce the wave-forms of the periodic currents which occur during nerve stimulus. As applied to recording sound vibrations, the author has adjusted the conditions of sensitiveness and periodicity, &c., to those necessary for frequencies up to 8,280, and states that it must be possible to reproduce vibrations of a frequency of 77,000. An idea of the sensitiveness can be obtained from the fact that a discharge of 4×10^{-12} coulomb could be demonstrated; that is the charge on a sphere of less than 4 cm. radius under a pressure of 1 volt. J. D. C.

2262. *Sensitive Braun Tube.* **A. Wehnelt.** (Phys. Zeitschr. 6. pp. 732–733, Nov. 1, 1905. Phys. Inst., Erlangen, Sept., 1905.)—The author has already shown that slowly-moving kathode rays can be obtained by using as kathode a hot platinum wire covered with CaO [see Abstract No. 548 (1904)]. Such a kathode is now used in a Braun tube, which can then be run off a lighting circuit. It possesses the advantages that much weaker fields are required to deflect the rays, and that the discharge is continuous, thus rendering observation of the spot on the fluorescent screen much easier. R. S. W.

2263. *New Vertical Intensity Variometer.* **A. v. Büky.** (Phys. Zeitschr. 6. pp. 536–545, Sept. 1, 1905.)—An astatic magnetic couple is suspended by a bifilar suspension, so that the magnets lie at right angles to the meridian. A vertical soft-iron bar is placed north or south of the couple, with one end on a level with each of the magnets. The bar is magnetised by the vertical component only of the earth's field, and both the poles so developed deflect the astatic couple in the same direction. Since the couple is as nearly as possible astatic, and is at right angles to the meridian, variations in the horizontal component of the earth's field have no appreciable effect upon it. The greatest disturbance is due to variation in temperature, and this is corrected for by a compensating magnet placed in the A position of Gauss with respect to one of the magnets of the couple. The calibration of the instrument by means of permanent magnets and also by means of electric solenoids and the determination of the best position for the compensating magnet are described. S. G. S.

2264. *Moving-coil Galvanometer.* **E. Gérard.** (Électricien, 30. pp. 184–185, Sept. 16, 1905.)—A new and convenient design of moving-coil galvanometer is described. It is so arranged that there is no enclosing glass case. One of the instruments has resistance 25 ohms, period 4 sec., deflection 28 div. per microampere at 1,000 scale div. distance of scale, and the sensitiveness referred to the ohm and second is 0·35. The instrument may be suspended by three indiarubber cords to damp out disturbing vibrations. S. G. S.

2265. *Absolute Wattmeter for Large Currents.* **C. Limb.** (Houille Blanche, 4. pp. 238–246, Oct., 1905.)—This is a mathematical paper dealing with a wattmeter in which the fixed circuit is a spiral of one complete turn and of pitch a little greater than the breadth of the rectangular strip employed in its construction. The movable circuit is a solenoid. It thus resembles a tangent galvanometer of one turn except that the magnetic needle is replaced by a moving coil. The formula for the accurate evaluation of the force is fully developed, both alternating and direct currents being considered. F. E. S.

ALTERNATING CURRENTS AND MAGNETISM.

2266. *Magnetic Properties of Demagnetised and Annealed Iron.* **J. Russell.** (Roy. Soc. Edinburgh, Proc. 25. pp. 849–852, 1904–1905.)—The paper is a preliminary communication on the subject. The iron is treated in three different ways: (i.) It is demagnetised by repeated co-directional reversals; (ii.) the same, using transverse reversals; and (iii.) it is demagnetised by annealing. In each case its magnetic properties after this treatment are observed. Amongst other conclusions are the following: The B-H curves for annealed and for co-directionally demagnetised iron cross each other, the former lying below the other at fields below 1·8 c.g.s. units; that for transversely demagnetised iron lies below the others for a wide range. The coercive force is the same whatever the method of demagnetisation, and the hysteresis energy is the same although the shape of the cyclic curve differs in the three cases. S. G. S.

2267. *Behaviour of Steel Magnets under Torsion.* **E. H. Wolf.** (Beibl. Ann. d. Physik, 29. 20. p. 1061, 1905. Extract of Dissertation, Strassburg, 1904.)—The experiments were made on steel wires, using a magnetometric null method, the deflection due to the magnets being annulled by the field produced by a compensating current. It is found that only after a large number of applications of the torsion, and subsequent detorsion, is the alteration produced at all regular. On the wire being twisted, the moment is altered to a certain extent, and on untwisting returns by another path to the initial value. The moment is, in general, diminished under torsion; in the case of a wire 21 cm. long a 30° twist reduces it about 5 per cent. With a somewhat thicker wire, however, an increase is observed under torsion and a decrease on detorsion—a behaviour which is peculiar to nickel. The cause of this peculiarity could not be determined. L. H. W.

2268. *Thermal Variations in the Magnetisation of Pyrrhotine.* **P. Weiss and J. Kunz.** (Comptes Rendus, 141. pp. 182–184, July 17, 1905.)—The authors have studied the properties of pyrrhotine at different temperatures by measuring the couples exerted by a rotating electromagnet on the substance suspended from a spring. They find there are two distinct varieties of pyrrhotine, viz., the compact crystals from Morro Velho (normal pyrrhotine) and the foliated masses from Morro Velho, New Jersey, and Bodenmais (abnormal pyrrhotine). *Normal* pyrrhotine possesses a true magnetic plane. Its saturation intensity decreases at first slowly with rising temperature, then more and more quickly, until it falls finally to zero. With *abnormal* pyrrhotines the magnetic plane is only a plane of magnetisation maxima. Pyrrhotine loses its ferromagnetism at 348°. [See also next Abstract.] D. H. J.

2269. *Hysteresis of Pyrrhotine.* **P. Weiss.** (Comptes Rendus, 141. pp. 245–247, July 24, 1905.)—A formula is given which expresses the hysteresis of the pyrrhotine in a rotating field, the energy lost in a cycle of magnetisation being calculated at 2,900 ergs, the maximum magnetisation 47, and coercive force 15·4. It is remarked that if the structure does not change until the temperature at which magnetism disappears (348°) is reached, the coercive force should decrease with the moment of the elementary magnetic particles, *i.e.*, with the intensity of magnetisation at saturation. In a field of 1,500 c.g.s. the hysteresis is found to disappear at 297°. [The whole subject is dealt with in Archives des Sciences, 19. pp. 537–558, June, and 20. pp. 213–230, Sept., 1905.] G. E. A.

2270. *Measurement of the Coefficient of Magnetisation.* **G. Meslin.** (Comptes Rendus, 140. pp. 1683–1685, June 26, and 141. pp. 102–106, July 10, 1905.)—The author suggests a modification of the apparatus of Curie and Chéneveau for the measurement of the coefficient of magnetisation; his arrangement is a combination of the torsion balance with an electromagnet, and is characterised by the fact that the two coils are never excited simultaneously, but only one after the other. A methodical study of the magnetic field with this apparatus enables the action at each point of the field to be determined, without the necessity of balancing this action by screwing the torsion-head till the experimental substance is brought back to its initial position. D. H. J.

2271. *Magnetic Viscosity.* **F. Rücker.** (Elektrotechn. Zeitschr. 26. pp. 904–905, Sept. 28, 1905. Extract of Inaugural Dissertation, Halle-Wittenberg, 1905. Écl. Électr. 45. pp. 181–182, Nov. 4, 1905.)—The author undertook an elaborate series of experiments with the object of ascertaining in how far ordinary magnetic tests were affected by magnetic viscosity. Four different materials were experimented on, and the results are given in tabular form, showing the influence of the number of steps on the apparent value of the induction. The greatest variations of the apparent induction with the number of stages by which that induction was reached, were found in each case to occur in the neighbourhood of maximum permeability. The most important result established by the experiments is as follows: In the case of ballistic measurements magnetic viscosity may, especially in the region of maximum permeability, introduce appreciable errors, which cannot be eliminated by increasing the period of the galvanometer. As saturation is approached, however, the error due to viscosity becomes very small. A. H.

2272. *Magnetic Susceptibility of Water.* **O. Scarpa.** (Elettricista, Rome, 4. pp. 261–265, Oct. 1, 1905.)—The balance method is employed, the water being contained in a vertical glass tube, the lower end of which is situated between the poles of an electromagnet. The apparent increase in weight due to the effect of the non-uniformity of the magnetic field enables the magnetic susceptibility to be calculated. The determination of the strength of magnetic field at various points is described. The author finds the value $-0{\cdot}80 \times 10^{-6}$ at 22° C. for the susceptibility of water relatively to air, and $0{\cdot}77 \times 10^{-6}$ for the absolute value. Within the errors of experiment, the susceptibility remains constant for all strengths of field. S. G. S.

2273. *Heat Developed during Cyclic Magnetisation of Iron.* **H. Delere.** (Beibl. Ann. d. Physik, 29. 22. p. 1166, 1905. Extract of Dissertation, Münster, 1905.)—A summary is given of the author's results: (1) The hysteresis loss in an iron tube was investigated at different frequencies and with different current strengths. (2) The value for the Thomson effect was determined. It is found that, contrary to earlier assumptions (Warburg), the Thomson effect constitutes a not inconsiderable portion of the hysteresis loss. (Here up to 15 per cent.) (3) For different values of the magnetising current, of determined actual maximum intensity, the total heat developed during cyclic magnetisation was measured in the case of a whole and a split iron tube. (4) The heat developed by eddy currents could not be directly measured, and so was taken as the difference between the total heat developed and the sum of the magnetising and Thomson-effect losses. (This gave results of the same order as were obtained for the heat due to eddy currents in brass under the same conditions.) (5) The eddy-current heat constitutes in most cases more than half the total heat developed; its amount is but little altered by slitting the tube. Increase of the cyclic frequency, however, reduces it in a considerably greater degree than the magnetising heat. L. H. W.

2274. *Irreversibility of the Heusler Alloys.* **B. V. Hill.** (Phys. Rev. 21. pp. 335–342, Nov., 1905.)—Of the alloys made by the author one contained about, in per cent., 60 Cu, 26 Mn, and 1·5 Al; the other contained a higher per cent. of Al. The alloys were very hard and brittle. A nickel heating coil was wound round a porcelain tube 70 cm. long and 2·5 cm. diam. This was put into a glass tube and packed with kaolin. This tube fitted into a brass water-jacket, and the magnetising coil was wound upon this jacket. The secondary coil was wound upon a smaller porcelain tube placed within the heating tube. The ballistic method of testing was employed, corrections being made for the demagnetising effects of the ends of the rod and for the space between the rod and the secondary coil. The rod first tested was made of the alloy containing the larger percentage of Al. When $H = 87$, $B = 5{,}750$ c.g.s. units, and the hysteresis loop had a large area. H was now kept constant and equal to 85, and the alloy was heated. Beginning with a magnetic intensity of 311 c.g.s. units the intensity falls, and vanishes when the temperature is 330° C. nearly. On cooling down, the curve of intensity and temperature lies below its former value, and at the initial temperature I is only 267. With the second heating the curve lies above that for the first cooling. When the temperature is about 300° it crosses the curve of the initial heating, and even at 500° I has a value of 7. After falling the second time to the initial temperature the intensity was only 27. Placed in liquid air I became 36, and on heating again to the normal temperature it retained this value. The specimen was now heated in the flame to dull-redness (650° to

700°) and allowed to cool slowly. When tested in the same way I was 90 when H was 85. The rod was then heated to a bright red (850°), and when cool I was 155. It was then cooled in liquid air and I became 162. Hence this is a new type of "irreversible" alloy, but the phenomena are in the opposite sense from those shown by the nickel steels. The second alloy tested had a smaller percentage of Al. Initially when H was 75, B was 11,800, and the hysteresis was small. It behaved in a very similar manner to the first alloy, but when heated to 950° and cooled it remained unmagnetic. There was a great difference in the density of this alloy in the magnetic and unmagnetic condition. When first cast the density was 6·61, but after annealing at 950° it was only 5·80. The change in the nickel-steels is in the opposite sense. A particular alloy of nickel and iron had a density of 7·91 when magnetic and 8·09 in the unmagnetic condition. There is possibly more reason to suspect chemical combination between the Mn and the Al in the Heusler alloy than between the Fe and Ni in the nickel steel, since the permeability of the former is greatest when the percentages of the two metals are proportionate to their atomic weights. These alloys have also the greatest density when in the magnetic state. A. R.

2275. *Influence of Solar Eclipse on Magnetic Field at Paris.* **T. Moureaux.** (Comptes Rendus, 141. pp. 471–472, Sept. 4, 1905.)—During the eclipse of the sun on Aug. 30, 1905, a temporary magnetic station was established by the Bureau de Longitudes at Poissy, under the direction of Mascart. A declinometer and a bifilar were installed for continuous registration, special conditions of sensibility being devised. One minute of time was represented by 1 mm.; for the declinometer curve 1 mm. was equal to 0′·8, and for the bifilar 1 mm. equalled 0·000035 c.g.s. The temperature was kept rigorously constant at 9°·5. Observations were commenced on Aug. 19, and continued until Sept. 2. Complete details of the results can only be given after reduction of the curve, but a short summary states that the declination was subject to several perturbing oscillations, of which the extreme amplitude was about 4′; the most pronounced minimum occurred at 0h. 36m., and the extreme maximum at 1h. 54m. The horizontal component was also disturbed, with a minimum at 0h. 6m., a little after the commencement of the eclipse, and a maximum at 2h. 27m., several minutes before the end; the total variation was about 0·00030 c.g.s. All these variations are much greater than the usual diurnal variations; normally, in Aug. the declination does not vary more than 1 min., and the horizontal component not more than 0·00008 between 0h. and 2h. During the eclipse the external temperature in the shade was reduced 1°·5, the minimum occurring about 1h. 30m., some 11m. after the instant of greatest phase of the partial eclipse. C. P. B.

ELECTRO-PHYSIOLOGY AND ELECTRO-THERAPEUTICS.

2276. *Action of Radium Bromide on the Electromotive Phenomena of the Eyeball of the Frog.* **J. G. M'Kendrick** and **W. Colquhoun.** (Roy. Soc. Edinburgh, Proc. 25. pp. 835–842, 1904–1905.)—The experiments were carried out with the eyeballs of frogs. The authors' conclusions are: (1) that the rays from radium bromide affect the electromotive phenomena of the living retina in a manner similar to that of ordinary light, but to a considerably less degree; (2) that this is due to direct action on the retina, and not to fluorescence of any of the structures of the eyeball, since no structure of the eyeball was found to be fluorescent when examined separately; (3) that the retina of the frog's eye will still respond to emanations of radium passing through cardboard blackened paper, thin glass, and aluminium-foil—emanations which are not perceptible to the human eye in a perfectly dark chamber; (4) that the retina is susceptible to the feeble light emitted by minerals and fluids rendered fluorescent by radium; (5) that most of the effects observed are due to the β-rays, but when these are as far as possible excluded, a slight effect persists, which, presumably, is due to the γ-rays; (6) that monochromatic light such as is employed in a photographic chamber may still alter the electromotive phenomena of the living retina. H. W. P. Y.

REFERENCES.

2277. *Electrodynamics of Moving Bodies.* **A. Einstein.** (Ann. d. Physik, 17. 5. pp. 891–921, Sept. 26, 1905.)—A mathematical investigation divided into a kinematical and an electrodynamical part. The former treats (1) Definition of contemporaneousness (Gleichzeitigkeit), (2) The relativity of lengths and times, (3) Theory of space- and time-transformations from resting to uniformly translated systems, (4) Physical significance of the equations obtained for moving rigid bodies, &c., (5) Addition theorem for velocities. The second part deals with (6) Maxwell-Hertz equations, (7) Doppler's principle and aberration, (8) Transformation of energy of light, Theory of radiation pressure on a perfect reflector, (9) Transformation of Maxwell-Hertz equations with reference to convection currents, (10) Dynamics of slowly accelerated electrons. E. H. B.

2278. *Dispersion, Reflection, and Absorption of Kathode Rays.* **W. Seitz.** (Jahrbuch d. Radioakt. u. Elektrotonik, 2. 1. pp. 55–67, May, 1905.)—A general review of work on this subject, with bibliography.

2279. *Velocity of Canal Rays.* **P. Ewers.** (Phys. Zeitschr. 6. pp. 500–502, Aug. 15, 1905.)—The author has recalculated, in the light of recent knowledge, the results of his measurements made six years ago [see Abstract No. 1899 (1899)]. R. S. W.

2280. *Experiments with the Nickel Filings Coherer.* **T. Chorvát.** (Beibl. Ann. d. Physik, 29. 19. p. 1003, 1905. Abstract of Inaugural Dissertation, Zürich, 1904.)—Numerous experiments are described in the original, dealing with the effect of different experimental arrangements and of a magnetic field on the resistance diminution produced by the applied p.d.'s. No very consistent results were obtained.

2281. *Thermo-electric Hysteresis; Thermo-e.m.f.'s of Copper-Zinc Alloys.* **E. Pinczower.** (Beibl. Ann. d. Physik, 29. 6. p. 291, 1905. Abstract of Dissertation, Freiburg, 1903.)—Deals with unsuccessful attempts to repeat P. Bachmetjew's experiments [Jurn. Russk. Fisik. Chimičesk. Obš. 29. p. 96, 1897]. The thermo-e.m.f.'s of 17 Cu-Zn alloys are also investigated, and the results used to discuss the constitution of these alloys. No numerical results are given in the Abstract.

2282. *Effect of Iron Cores on Self-induction of Coils.* **W. Hamacher.** (Beibl. Ann. d. Physik, 29. 1. p. 43, 1905. Abstract of Dissertation, Münster, 1904.)—Experimental results as to effect of iron cores of different length and kinds when inserted in a solenoid, with continuous and alternating currents. It is found that the self-induction, in general, with a given magnetising current, reaches a maximum which is the greater, the greater the mass of iron employed.

2283. *Electric Resonance.* **W. Lebedinski.** (Ind. Élect. 14. pp. 416–423, Sept. 25, 1905. From Electritchetsvo.)—A *résumé* of the theory of resonance or syntony in the case of electric systems. E. H. B.

2284. *Study of Circuits Containing Resistance, Induction, and Capacity.* **J. S. Dow** and **F. Creedy.** (Elect. Engin. 36. pp. 150–152, Aug. 4, 1905.)—This paper treats of circuits with alternating currents by means of "the circle-diagram," which is a modification of the "clock-face diagram" method of obtaining results in alternate-current circuits. The circuits which are considered in this paper are: (1) Circuit containing resistance and reactance (both inductive and capacity) in series; (*a*) Constant resistance, (*b*) Constant reactance, (*c*) Resistance and reactance both variable. (2) Capacity and impedance in parallel; (*a*) Variable self-induction, (*b*) Variable resistance, (*c*) Variable capacity, and (*d*) Variable frequency. E. C. R.

2285. *Practical Standards for Electrical Measurements.* (Electrician, 55. pp. 856–858, Sept. 15, 1905. Report to British Association by Committee on Electrical Standards. Centralblatt Accumulatoren, 6. pp. 241–242, Oct. 15, 1905. Abstract.)—Further particulars as to progress with the ampere balance [see Abstract No. 3261 (1904)]. In an appendix by **F. E. Smith,** the preparation of materials for a standard cadmium cell is dealt with, four methods of preparation being described.

2286. *Convenient Form of Oscillograph.* **F. A. Laws.** (Elect. World and Engineer, 45. pp. 839–840, May 6, 1905.)—A form of vibrating-strip oscillograph for ordinary laboratory use is described. The instrument was made in the Massachusetts Institute of Technology, and is claimed to be more robust and much more readily repaired than the Duddell pattern. The details of the apparatus are fully illustrated. D. K. M.

2287. *Registering Galvanometer.* **F. Hoffmann** and **R. Rothe.** (Zeitschr. Instrumentenk. 25. pp. 273–278, Sept., 1905. Communication from the Physikal.-Techn. Reichsanstalt.)—A description of a galvanometer by Siemens and Halske, designed specially for work in thermochemistry. A copper-constantan thermo-element is used to give temperature curves, the registering apparatus being the same as in the firm's "registering pyrometer" [see Abstract No. 564 (1905)]. A. W.

2288. *Electrostatic Analogy to Diamagnetism.* **M. Seddig.** (Phys. Zeitschr. 6. pp. 414–415, July 1, 1905. Phys. Inst. d. Univ., Marburg.)—Discusses other possible interpretations which may be put upon the results of the experiments of L. Puccianti which showed an electrostatic repulsion of bubbles of air in vaseline oil analogous to those in the case of diamagnetism. [See also Abstract No. 911 (1903).] E. H. B.

2289. *Variation of Hysteresis in a Rotating Field.* **R. Arnò.** (Electrician, 55. p. 469, July 7, 1905. From the Italian.)—A translation giving the chief results described by the author in five papers, of which two, containing all the main substance, were dealt with in Abstracts Nos. 1048 and 1289 (1905). In an editorial (Ibid. pp. 450–451) Arnò's explanation is criticised.—**L. H. Walter.** (Ibid. p. 558, July 21.)—A further criticism.

2290. *Law of Electromagnet.* **P. Schiemann.** (Zeitschr. Elektrotechn., Wien, 23. pp. 483–484, Aug. 13, 1905. Écl. Électr. 44. pp. 471–473, Sept. 23, 1905.)—Starting from the principle of the conservation of energy, the author establishes the following expression for the mechanical work done by an electromagnet in attracting its armature: Work done $= \frac{1}{2}A(N_2 - N_1)$, where $A =$ ampere-turns, $N_2 - N_1 =$ change of flux due to displacement of armature. A. H.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

2291. *Absorption of Hydrogen by Rhodium and Palladium.* **L. Quennessen.** (Bull. Soc. Chim. 33. No. 3. pp. 191–193, Feb. 5, 1905. Chem. News, 92. p. 163, Oct. 6, 1905.)—Palladium sponge, obtained by reduction of ammonium chloropalladate and cooled in a current of hydrogen, causes the formation of water vapour, when in contact with air. After reheating the palladium, again cooling in hydrogen and driving out the atmosphere of hydrogen by means of a current of dry carbonic acid, an abundant condensation of water vapour still occurs when air enters the tube; this does not take place with rhodium. Rhodium, therefore, does not resemble palladium in its chemical affinity for hydrogen, but acts like platinum sponge in the condensation of hydrogen and oxygen to form water. [See also Abstract No. 290 (1905).] W. H. Si.

2292. *Dewar's Method of Producing High Vacua.* **Blythswood** and **H. S. Allen.** (Phil. Mag. 10. pp. 497–512, Oct., 1905.)—Some experiments upon the rate of absorption of air by charcoal cooled in liquid air [see Abstract No. 2919 (1904)]. It is found that if p be the initial pressure, and p_0 the pressure after time t, the relation holds good that $\log (p - p_0) = A + \lambda t$, where A and λ are constants. From this the authors deduce the velocity of absorption $dx/dt = X(\xi - x)$, where x is the total amount of the air the charcoal can take up and ξ the amount absorbed when equilibrium is reached.

E. C. C. B.

2293. *Law of Corresponding States.* **H. Happel.** (Phys. Zeitschr. 6. pp. 389–397, June 15, 1905.)—A review of theoretical and experimental work in connection with van der Waals' law of corresponding states. After giving an account of the general theory of Kamerlingh Onnes relating to corresponding states, the author sketches the experimental investigations of Amagat, Raveau, Ramsay and Young, Young, Young and Thomas, K. Meyer, Mathias, Reinganum, and others. In so far as the law of correspondence of state is concerned, most substances would appear to fall into at least three classes, as representatives of which argon, ether, and ethyl alcohol may be taken. Acetic acid, methyl alcohol, and some other substances do not belong to any of the three classes. In each class the correspondence is fairly good, whilst substances of one class do not correspond with those of another. The question is discussed as to how far phenomena such as polymerisation, dissociation, &c., enter into the question. F. G. D.

2294. *Dineric Equilibria.* **J. M. Bell.** (Journ. Phys. Chem. 9. pp. 531–555, Oct., 1905.)—The author starts from Bancroft's equations and arrives at the following conclusions among others as the result of a series of measurements on various systems. 1. The dineric equilibria of two liquids and a solid may be represented by mass law action when non-electrolytes; the solid mass is constant, for aqueous solutions are not used. 2. If z and y are the mass concentrations of the common solvent and of the precipitating liquid with reference to the constant solid mass, the complete equilibrium will be given by $f(x)\ y^{\beta}/z^{\gamma} = \kappa$ and also $dy/dz = ny/z$, where β, γ, κ and n are constants and $f(x)$ is an undetermined function of the concentration of the solid component. H. H. F. H.

2295. *Ionic Sizes in Relation to the Conductivity of Electrolytes.* **W. R. Bousfield.** (Zeitschr. Phys. Chem. 53. pp. 257–318, Oct. 10, 1905. Translated from the English. Roy. Soc., Proc. 74. pp. 563–564, April 10, 1905. Abstract.) —If Stokes' observations as to the motion of a sphere in a viscous fluid be applied to the motion of the ions of a binary electrolyte, it is necessary, in order to account for the experimental data, to suppose that the ions are molecular aggregates composed largely of water, and that the size of the ion varies with the temperature and concentration, owing to changes in the amount of combined water. The variation of ionic radius with temperature may be expressed by a quadratic formula of the ordinary type, and in the case of KCl the influence of concentration is given by the formula: $r_{\infty} = r(1 + 3{\cdot}33h^{-\frac{2}{3}})$, where h is the hydration, *i.e.*, the ratio of the number of molecules of solvent to molecules of solute. The coefficient of ionisation is then given by the formula: $a = \Lambda/\Lambda_{\infty} . 1/f . 1(1 + 3{\cdot}33h^{-\frac{2}{3}})$, where f is the fluidity of the solution. Similar conclusions are arrived at by studying the densities of the solutions, the assumption being made that the contraction which occurs when the salt is dissolved is proportional to the amount of water that enters into combination. T. M. L.

2296. *New Formation of Diamond.* **W. Crookes.** (Roy. Soc., Proc. Ser. A. 76. pp. 458–461, Sept. 13, 1905.)—From consideration of the known thermal data of carbon, with the aid of the analogy of such substances as arsenic, carbon dioxide, and silicon fluoride, the conclusion is reached that the critical point of carbon lies at 5,800° abs., with a corresponding pressure of 15 tons per sq. in.; above this temperature no amount of pressure would liquefy carbon, but at 4,400° abs. a pressure of above 17 atmos. would suffice to liquefy some of it. A. Noble has recently obtained pressures of 50 tons per sq. in. with temperatures rising to 4,000° C.; under these conditions, if the time of explosion were sufficient to allow the reaction to take place, we should certainly expect to find some of the carbon solidifying from the liquid state in the crystalline form. The author has examined the residues from some of the explosions above referred to, and by chemical treatment has isolated some microscopic crystals whose appearance, chemical behaviour, and optical properties lead to the conclusion that they are diamonds.
W. Ros.

2297. *Iron-Silicon Alloys.* **W. Guertler** and **G. Tammann.** (Zeitschr. Anorg. Chem. 47. 2. pp. 163–179, Oct. 20, 1905. Metallographic Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Alloys of iron and silicon were prepared by melting together pure iron containing less than 0·28 per cent. of total impurities (including carbon), and silicon prepared electrochemically, containing over 98 per cent. Si. The alloys were melted in porcelain tubes, but those rich in Si attack porcelain perceptibly, so that the porcelain tube protecting the thermo-couple had to be covered with platinum-foil and a layer of magnesia to further protect it. With the alloys poorer in Si, however, the analysis agreed closely with the synthetical composition of the alloys. A temperature-concentration diagram is given, but all changes occurring below 1,100° C. have been neglected; it has been found, however, that the magnetic change-points of the alloys lie at or very near the temperature at which this change occurs in pure iron, the authors concluding that the allotropic change-points of iron are not materially affected by the presence of Si. From the concentration diagram, as confirmed by examination of the micro-structure, the authors describe the following constituents: Primary crystals of Fe and Fe_2Si as mixed crystals from 0 to 33·3 atomic per cent. Si; the compound Fe_2Si from 33·3 to 35·5 per cent. Si; the compound FeSi from 35 to 76 per cent. Si, and pure Si from 76 to 100 per cent. Si. Secondary crystallisations of two eutectics, one consisting of Fe_2Si and FeSi, freezing at 1,235°, and the other consisting of FeSi and Si, freezing at 1,245°. The compound Fe_2Si freezes at 1,251°, while FeSi freezes at 1,443°. W. Ros.

2298. *Copper and Arsenic.* **K. Friedrich.** (Metallurgie, 2. pp. 477–495, Oct. 22, 1905. Communication from the Metallog. Laborat. d. k. Bergakad., Freiberg.)—The first portion of the paper describes the methods of obtaining temperature-concentration diagrams, their interpretation and verification by the aid of the microscope. The diagram of the Cu-As series up to about 50 per cent. As is given, with 23 photomicrographs of the structures observed. The diagram shows in addition to the curve of freezing-points four horizontal lines; three of these, lying at 683°, 711°, and 603° C. respectively, correspond to three eutectics, but no explanation of the fourth line is given. The freezing-point curve has one visible and one "suppressed" maximum, corresponding to the formation of the compounds Cu_3As and Cu_5As_2, and the existence of these compounds may be regarded as established. On the other hand, the formation of Cu_6As, found in nature as algodonite, and of Cu_2As, does not occur on melting the two metals together; the same applies to the natural mineral whitneyite (CuAs). The range of alloys studied does not cover the compound Cu_3As_2. In the Cu-As compounds the As is held comparatively loosely; alloys rich in As lose the greater part of their As content on prolonged heating even at 300°. When such alloys are quenched in water or oil, almost pure As is separated in the form of a brown mud. Alloys containing less than 70·88 Cu rapidly assume a red colour when treated with an ammoniacal solution of cuprammonium chloride; alloys richer in Cu do not show this red colour, but no explanation for this behaviour has been found.

W. Ros.

2299. *Dissociation of the Hydrogen which has diffused through Certain Metals.* **S. Guggenheimer.** (Phys. Zeitschr. 6. pp. 579–581, Sept. 15, 1905.)—The author finds that the hydrogen dissolved by palladium and by sodium and liberated by heating to 200° does not discharge a conductor whether the charge on this be positive or negative, and he concludes from this that the results of A. Winkelmann [see Abstracts Nos. 2195 (1901) and 2279 (1902)] and of O. W. Richardson [see Abstract No. 1219 (1904)] must not be taken to indicate that the hydrogen that diffuses through metals is dissociated. [The results given do not seem to warrant the conclusion arrived at, which appears to be unsound.] S. G. S.

2300. *Electric Kataphoresis.* **M. v. Smoluchowski.** (Phys. Zeitschr. 6. pp. 529–531, Sept. 1, 1905.)—According to A. Cruse [see Abstract No. 1138 (1905)], the fact that a maximum in the rate of transmission occurs at temperature 35° to 40° is not in accordance with the equation of Helmholtz. It is pointed out that the conditions as regards temperature of the double layer in the experiment of Cruse are not definitely known. Using the values of the conductivity and viscosity of pure water as given in Landolt and Bornstein's tables, the author shows that a maximum of transmission of water would be expected at temperatures 35–40°, according to Helmholtz's formula. The author next obtains an expression for the relative apparent increase of conduction due to the double layer when the thickness of this is of the order of molecular dimensions, so that the ordinary formula for flow in terms of thickness and viscosity is not applicable. S. G. S.

2301. *Theory of the Residual Current.* **W. Nernst and E. S. Merriam.** (Zeitschr. Phys. Chem. 53. pp. 235–244, Sept. 19, 1905.)—By making use of a small excentric and quickly rotating electrode, which is placed opposite to a second, large, constant electrode, the authors have been able to make a rapid and accurate determination of the residual current. In all cases where the action of the depolariser is quick compared with that of the velocity of diffusion (the halogens Cl, Br, and I, and potassium permanganate), the residual current can be treated as a diffusion problem; the agreement between theory and experiment was very satisfactory, affording, at the same time, a confirmation of the Nernst-Brunner theory of the velocity of reaction in heterogeneous systems. In those cases where the depolariser acts slowly (chromic acid, potassium perchlorate, ferrous sulphate, potassium ferro- and ferri-cyanides, stannous chloride, persulphuric acid) the residual current is less than it should be theoretically; at the same time the influence of the velocity of rotation of the electrode disappears to a greater or less extent. In a similar manner, but using two rotating electrodes instead of one, the residual current of the acid-alkali depolarisation has been measured; it admits of a very sharp determination of the neutral point between acid and alkali. T. S. P.

2302. *Alternate-current Electrolysis.* **E. Wilson.** (Faraday Soc., Trans. 1. pp. 305–312, Aug., 1905. Chem. News, 92. pp. 198–200, Oct. 27, and pp. 206–208, Nov. 3, 1905. Écl. Électr. 45. pp. 110–113, Oct. 21, 1905.)—The paper gives an account of some experiments made to determine the effect upon certain metals of passing alternating currents between them and certain electrolytes under given conditions. The apparatus employed and the method of working are described. Details are then given of experiments made with various metals in various electrolytes, two identical plates of the same metal being employed in each experiment. The tests made were as follows: Lead in dilute sulphuric acid; zinc (amalgamated) in dilute sulphuric acid, in zinc chloride, in zinc sulphate, and in sodium sulphate; iron in ferrous sulphate and in sodium chloride; copper in copper sulphate, sodium chloride and sodium phosphate; tin in protochloride of tin, and aluminium in potash alum solution. In addition to curves for the different results a complete table is given showing duration of each experiment, frequency, temperature, difference in weight, &c. J. L. F. V.

2303. *Electrolysis of Molten Potassium, Sodium, and Lithium Nitrates.* **A. Bogorodsky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 6. Chemical part, pp. 703–759, 1905.)—In order to explain the chemical processes that occur during the electrolysis of molten metallic salts, the author has electrolysed the nitrates of sodium, potassium, and ammonium at temperatures near their melting-points. Different e.m.f.'s were employed, and the gaseous decomposition products were estimated; the anodic and kathodic portions of the electrolyte were analysed. As kathodes, aluminium and graphite were used; as anode, platinum. It was found that the anodic gases consist wholly of oxygen and nitrogen tetroxide, and that when the electrolysed mass was put into water, free oxygen as well as nitrate was to be detected. During electrolysis of potassium and sodium nitrates with currents at 5–35 volts the molten masses became bright yellow to orange-red at the kathode, and yellow precipitates, believed to be peroxides of the metals formed by oxidation of the primarily liberated metal, separated out. Fused lithium nitrate remains colourless at the kathode and orange-red at the anode during electrolysis. With currents at over 6 volts the separation of metallic lithium at the kathode could be observed. Quantitative examination of the anode gases showed that in accordance with the equation—

$$KNO_3 = K + NO_2 + O,$$

1 gm.-atom of O and 1 gm.-molecule of NO_2 was liberated for every gm.-atom of Ag set free by the current in the voltameter. The ratio of alkali oxide to alkali nitrite in the kathodic liquid varies with the nature of the kathode. The author is of opinion that when graphite is employed for the electrolysis of KNO_3 the separated potassium becomes oxidised to KO, which, in its turn, reacts with the carbon of the kathode as follows: $KNO_3 + K = KNO_2 + KO$; $4KNO_3 + 4KO + C = 4KNO_2 + K_2O + K_2CO_3$. With Al kathodes only the first process occurs. Under the same conditions lithium seems to be oxidised to Li_2O. Sodium occupies a mean position. D. H. J.

2304. *Estimation of Cadmium, using a Rotating Kathode.* **C. P. Flora.** (Amer. Journ. Sci. 20. pp. 268–276, Oct.; 392–396, Nov., and pp. 454–455, Dec., 1905. Contribution from the Kent Chem. Lab. of Yale Univ. Zeitschr. Anorg. Chem. 47. 1. pp. 1–12, 13–19, and pp. 20–22, Oct. 3, 1905.)—The following is a summary of the results obtained in the estimation of cadmium, using a rotating kathode. Cadmium can be accurately estimated by deposition from solutions of the sulphate containing sulphuric acid, sodium acetate, or potassium cyanide; the results are also satisfactory when the solution contains carbamide, formaldehyde, acetaldehyde, pyrophosphates, phosphates, tartaric acid, or formic acid. From solutions containing oxalates or oxalic acid, ammonium tartrate, or potassium formate, satisfactory deposits could not be obtained. In the case of the chloride of cadmium good results are obtained when the solution contains sulphuric acid, potassium cyanide, or pyrophosphates. Only by the exercise of very great care could deposits free from spongy cadmium be obtained from solutions containing carbamide, formaldehyde, or acetaldehyde. Chloride solutions containing acetates, oxalates, formates, tartrates, formic acid, oxalic acid, or tartaric acid, gave negative results. Solutions of cadmium nitrate cannot be used for electrolytic depositions, except when they contain potassium cyanide. From solutions containing 1 per cent. or more of free nitric acid cadmium cannot be deposited. [See also Abstracts Nos. 456 and 2797 (1904).] T. S. P.

2305. *Anodic Behaviour of Zinc and Manganese.* **W. J. Müller.** (Zeitschr. Elektrochem. 11. pp. 755–763, Oct. 27, 1905. Paper read before the 12 Hauptversamml. d. Deutsch. Bunsen-Gesell. June 1–4, 1905.)—Having studied the anodic behaviour of manganese and the valency with which the metal passes into solution, with especial regard to passivity, the author investigates zinc in an analogous manner. The applied electrolytes are sodium sulphate and sodium phosphate, both alkaline and acid. Abnormal polarisations were observed, particularly when OH′-ions were present. The author regards these polarisations as passivity phenomena, which he explains on the basis of his electron theory of passivity. [Compare Abstract No. 493 (1905).] H. B.

2306. *Alternating-current Electrolysis.* **M. Le Blanc.** (Zeitschr. Elektrochem. 11. pp. 705–708, Oct. 27, 1905. Paper read before the 12 Hauptversamml. d. Deutsch. Bunsen-Gesell. June 2, 1905.)—The author confirms his former experiments and conclusions [see Abstract No. 1233 (1904)]. Continuous currents do not deposit copper from cyanide solutions, because complex ions are formed. If however, with alternating current, the kathodic impulse succeeds the anodic impulse before the copper ions have had time to react with the cyanide solution, the dissolved copper will be re-deposited. With 1,000 alternations per min. the solution of copper proceeded quantitatively; with 38,000 alternations only one-third of the former amount was dissolved. That would indicate that the reaction between the copper ions and the solution is complete after an interval of 0·001 min., and has probably —if extrapolations may be relied upon—not begun before the expiration of 1/80,000 min. Details of the renewed experiments, made by Löb, are given. It is necessary in such experiments that the currents be asymmetrical, the one impulse, *e.g.*, three times as long as the other. For this purpose the author applies a mechanical commutator, and he is now constructing one which will give 25,000 alternations per sec. (not per min.). If the copper electrode is in the passive or noble state, that is to say, previously heated and quenched in alcohol, so that its surface becomes amorphous instead of crystalline, the relative losses and gains of the electrodes, which are essentially anode or kathode respectively, will change. In making the above estimate of the velocity of the reaction between ions and solution, the author presumed that no time is required for the transition of the copper from the metallic into the ionic state. There is a time interval, however, and its length determines the passivity of the metal. The author discusses the influence of alternating current on this passivity for copper and nickel, and refers to Brochet and Petit. H. B.

2307. *Ferric Oxide Electrodes.* (Electrochem. Ind., N.Y. 3. p. 392, Oct., 1905.)—Magnetic oxide of iron electrodes are prepared, according to the process of H. Specketer, by smelting ordinary oxide, *e.g.*, purple ore, in an electric furnace the bottom of which is connected with the positive pole, a movable vertical carbon rod being placed above and connected to the negative pole. The molten mass flows from the furnace through a channel in the wall into a properly shaped mould. Such electrodes are considerably cheaper and last much longer than those of carbon, they furnish chlorine free from carbonic acid, and require a lower p.d. than platinum electrodes.

W. H. Sl.

REFERENCE.

2308. *Separation of Samarium, Europium, and Gadolinium.* **G. Eberhard.** (Zeitschr. Anorg. Chem. 45. 4. pp. 374–384, July 8, 1905. Kgl. Astrophys. Observatorium, Potsdam, May 8, 1905.)—The author has photographed the spectra of certain fractions obtained by the method of Urbain and Lacombe, by means of a concave grating, and by comparison of the plates with those of many alkaline earths he concludes that the fractions are perfectly pure Sm, Eu, and Gd respectively, thus proving the value of the method. E. C. C. B.